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This issue, March, 1947.

CIVIL ENGINEERING

Engineering at Cornell (21)

By W. LINDSAY MALCOLM
Director of the School of Civil Engineering

Any consideration of Civil Engineering and the School of Civil Engineering at Cornell must naturally be divided into three phases: the past, the present, and the future. This is to the writer a necessity, as the future holds the point at which we are aiming, the present shows how we are progressing, and the past the foundations on which we are building.

There must of course be a central theme or direction. To the writer it is obvious that the instruction of the undergraduate should be the prior objective. Instruction of graduate students and research are most important. They help in enlarging the view of those engaged in these phases and without doubt help in the teaching of students in the undergraduate group. It is difficult to maintain a happy balance between these phases of University work. Administration is apt to stress research, graduate study, and the writing of books and papers too highly because of the advertising value. Too often the good teacher does not get deserved recognition and too often the highly advertised professor does little or no teaching of the undergraduate body. When he does, the teaching is often fringed with mediocrity either because of lack of ability to teach or lack of interest in the more elementary work.

With this as a theme, let us examine the course of the School of Civil Engineering from the past and try to see what may lie ahead.

The Past

The College of Civil Engineering was started in 1868 with Professor E. A. Fuertes, familiarly known to students of his time as the "Mog" (evidently a shortened form for Mogul), as Director. His interests lay largely in the field of Hydraulics and Sanitary Engineering. Like Thurston in the College of Mechanical Engineering, Fuertes was a believer in laboratory training. This was evinced in his development of the Hydraulics Laboratory.

Fuertes was a believer in good teaching. He attracted to his staff men like I. P. Church, H. S. Jacoby, and C. L. Crandall. These were names to conjure with during the early days. While the writer did not receive his first degrees from Cornell, he used textbooks by these teachers and looked upon Cornell as being extremely fortunate in having such a celebrated group.

It was upon the teaching of these celebrated men that the foundations of the College of Civil Engineering and the present School of Civil Engineering were laid. The theme of these men was sound basic training with rigorous attention to fundamentals.

The Present

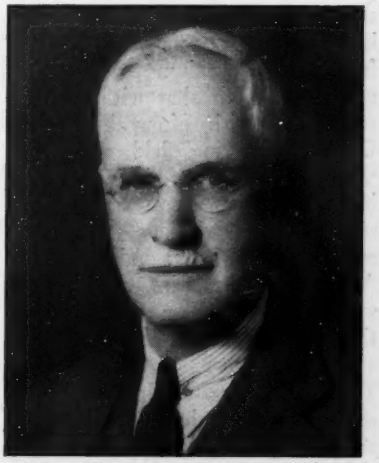
Like all educational institutions, Cornell is suffering one of the aftermaths of war. The interrupted education of many who were engaged in the war is being resumed. To take care of these returning students as well as to take care of the high school graduate has placed a very heavy burden on this institution. In our own case the spring term of 1946 saw 246 undergraduates and 17 graduate students enrolled. The following term saw us with 432 undergraduates and 41 graduates. The staff has had to be augmented. Since all other institutions are look-

Cornell's Civil Engineering hydraulic lab and famous Fall Creek Gorge, with Beebe Lake behind the lab.

THE AUTHOR

Dr. William Lindsay Malcolm received an M.A. in 1905 and a B.S. in C.E. in 1907 from Queens University in Ontario. During World War I he attained the rank of lieutenant-colonel in the Canadian Engineers. He taught at Queens University until 1938, when he was appointed Director of the School of Civil Engineering at Cornell. Cornell had awarded him an M.C.E. in 1934 and a Ph.D. in C.E. in 1937.

Dr. Malcolm has wide experience in municipal engineering and construction. He holds membership in ASCE, Engineering Institute of Canada, New York State Sewage Works Association, and other professional societies. He is also a member of Phi Kappa Phi, Sigma Xi, and Chi Epsilon.



Dr. Malcolm

ing for staff members and since industry is offering high rates of wages, it is very difficult to obtain the type of men we wish. We have been singularly fortunate in inducing a few men to come to us, primarily because they are interested in teaching or in some phase of academic life. Further, the graduate students have most willingly given us marked assistance. Without them it would have been almost impossible to carry on. It has been deemed advisable not to fill permanent positions until we have been assured that we can obtain competent personnel. It is believed that the method adopted will give a more satisfactory solution of our teaching problem than to take on indiscriminately just those who are available.

The staff is overloaded in many areas, but by shifting men from one area to another in whole or in part, it is hoped that we will be able to carry the burden until we get on an even keel. The graph showing the numbers in each term in the current term and the expected enrollment in the coming spring term indicates that we will have this pressure on us for two or three years yet.

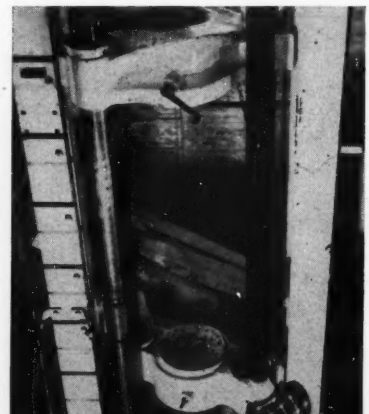
Owing to the scheduling of the service courses, particularly in Chemistry and Physics, no freshmen can be taken care of in the spring term commencing Feb. 17th.

The five year curriculum was started at the beginning of the present term for entering high school students. A few "veteran" entrants have already transferred from the four year curriculum to this new one. It was felt that with the increased breadth of work in the Civil Engineering field and with the increased competition, certain instruction was necessary. Fields such as Labor Relations, Public Administration, Money and Banking, Accounting, Statistics, and others which were becoming areas in which the Civil Engineers have found it necessary to work, have been added. The four year course already crowded with essentials had to be expanded to accommodate the courses thought necessary. To this end, about one term of what may be termed non technical courses was added. The technical courses were expanded by about a term's work, the additional work being added across the entire field of Civil Engineering.

To accommodate the design and computing classes, the museum at the north end of Lincoln Hall has been turned into a drawing room and the drawing room in the north end of the fourth floor has been revamped.

The soils laboratory has been doubled in size by taking over the room to the north. This has enabled larger classes in the laboratory to be accommodated.

The hydraulics laboratory has been undergoing a slow but steady change. Duplicate laboratories and equipment have been installed to double the capacity of the work in elementary hydraulics and fluid mechanics.



Baldwin Southwark 300,000 pound testing machine.

In late years additional equipment has been added to the materials testing laboratory. A 400,000 lb. testing machine for testing concrete cylinders and blocks was added a very few years ago. This has enabled us to relieve the work done by 300,000 lb. column and the 200,000 lb. beam machines. The older machines have been motorized.

In Sanitary Engineering, additions have been made to the Laboratory. The equipment is fairly comsion is great.

In the Highways Laboratory, two small size testing machines have been powered. Mixing apparatus, balances, and other equipment which have been added will enable us to do more and better work.

The Future

To enable this school to do satisfactory research and proper demonstration for undergraduate courses in hydraulics, plans are in hand for the construction of a hydraulics laboratory on a site at the easterly end of the "canal." It is the intention to cover the canal so that winter work can be done and to revamp the present laboratory into a research laboratory. The available "head" at Triphammer Falls gives this laboratory a unique place in the field of hydraulics.

Plans have also been drawn for the construction of a sanitary engineering laboratory where operational work on semiplant scale can be done. In such a building, modern water and sewage treatment can be demonstrated to the student. Graduate students will be able to undertake research on many lines.

In the development of soils research, and highway and airport construction and design, it is hoped that within a comparatively short time additional space will be available in which investigations in soil stabilization can be followed through. The Transportation Department is developing work along the line of soil identification from aerial photographs. Work in traffic problems has also been added to the school work.

The development of new technique and methods of surveying, particularly in aerial surveying, require additional work to be done by the Surveying Department. The advance in equipment has been great and it is the intention of this school to obtain such equipment as to keep us in the forefront of our work.

In the background of course will be the new buildings to house the School. This will give much needed additional room for lecture and recitation work. Additional drawing rooms will be provided, and laboratories for soils, highway work, with plete but the need for room expandemonstration rooms for instruction

(Continued on page 40)

SILICONES---
RECENT DEVELOPMENTS AND APPLICATIONS

By SHIRLEY FIKE, Arts '49

All cuts courtesy U. S. Navy

The need for lighter weight motors, for moisture resistant motors having greater endurance at high temperatures, and for motors having an increased horsepower, has been met by the recent development of silicone insulation. Silicones, which bridge the gap between organic materials, such as cotton, rubber, and oil, and the pure inorganic materials such as asbestos, glass, and sand, have introduced a new era in insulation.

The use of silicone insulation in machines such as motors for trolley coaches, streetcars, mining locomotives, powerhouse auxiliary-drive motors, and ships' generators, has resulted from the findings of many tests of silicone resins.

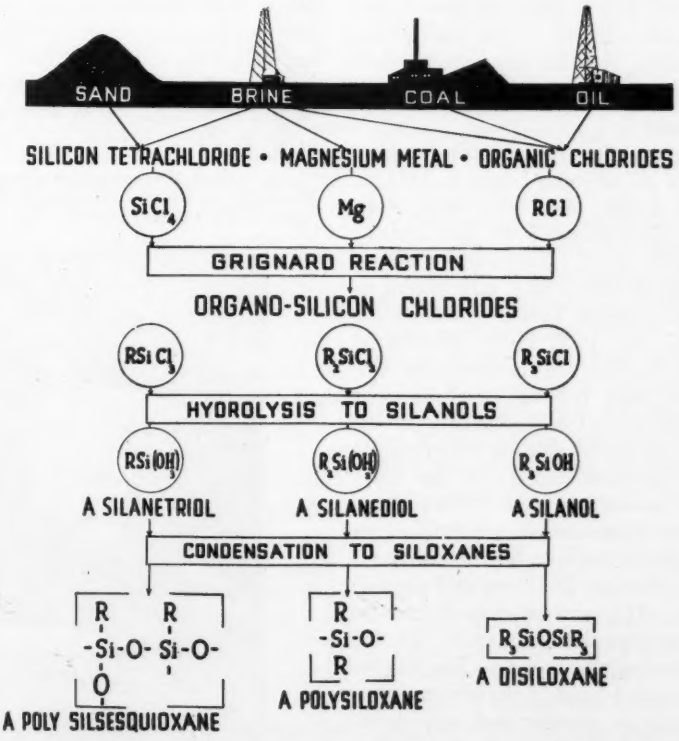
Thermal Endurance

Flexing-life tests of a silicone resin and one of the better organic resins showed that silicone varnish has a much greater thermal endurance. According to another series of laboratory tests, silicone varnishes have superior moisture resistance. When a complete motor was tested for 3376 hours at a temperature of approximately 250 degrees C., the test finally ended because of bearing failure, while the silicone insulation was still in good condition. Tests on two ship's generators showed that the generator having the type of insulation formerly used failed at forty per cent of the time the test was applied without failure to the silicone insulated machine.

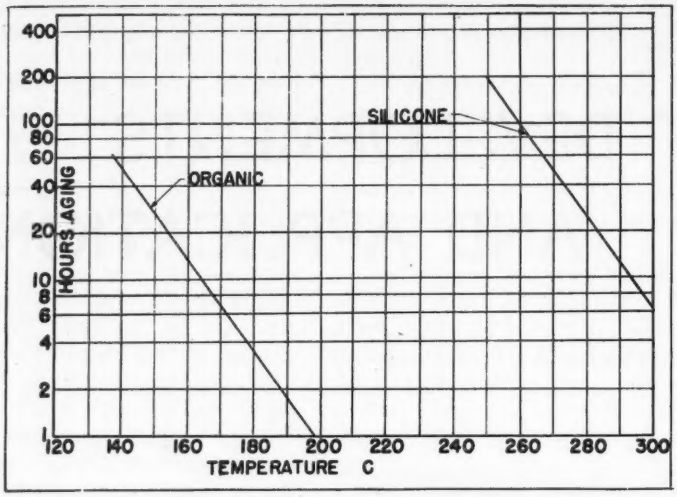
Dow, Corning, and Westinghouse undertook a large scale motor test at Midland, Michigan, to show the ability of silicone insulation to endure under actual operating conditions. These tests, which involved subjecting the motors to extremely high temperature runs and then allowing them to cool in a high-humidity atmosphere, show that silicone insulation has far greater temperature stability and moisture resistance than any materials previously used.

Silicone insulation makes it possible to reduce to normal size enclosed fan cooled motors, which are now built much oversize. An operating coil of a magnetic contactor designed for 100-percent duty with silicone insulation was fitted into the same space occupied before by a coil built for 70-percent duty. In marine propulsion, weight and size are at such a premium that loss in performance is in some cases offset

THE FORMATION OF SILICONES



SIMPLE TYPES OF STRUCTURAL UNITS PRESENT IN SILICONES



Results of a series of flexing life tests for a silicone resin and one of the better organic synthetic resin (phenolic-alkyd) varnishes are shown. These tests clearly indicate the different order of magnitude of the thermal endurance of the silicone varnish.

by reduction in weight, the result of silicone insulation.

Silicones have made possible the building of machines with much higher operating speeds and temperatures than those formerly achieved. When the complete redesign of a large ship propulsion motor was undertaken in order to take full advantage of the temperature increase permitted by silicone insulation, there was more than a twenty five percent increase in output attributable to the silicone insulation, and this was accomplished with no increase in weight.

History

Although early development work on silicones began in 1861, it was during the 1930's when work was first initiated in this country by Dr. E. C. Sullivan of Corning Glass Works, who is also known as "the father of Pyrex." At this same time, Dr. J. F. Hyde synthesized the first flexible, thermosetting silicone resin polymer. Development progressed rapidly, resulting in the production of silicone materials for special purposes early in the war.

Silicones are a new class of organo-silicon compounds built on an inorganic skeleton of silicon-to-oxygen linkages in a long chain structure. Hydrocarbon radicals derived from organic compounds are attached to this skeleton. The silicon-to-oxygen bond of the silicone compounds is stronger and more heat-stable than the carbon-to-carbon bond of the organic hydrocarbon compounds. Silicones are derived from sand, brine, coal and oil, the first step being the formation of silicon tetrachloride by heating sand with coke and chlorine from brine. Organic chlorides, made from hydrocarbons derived from coal and oil by treatment with chlorine from brine, are attached to silicon through the use of magnesium metal, also from brine. One or more chlorine atoms in silicon tetrachloride is replaced with a hydro-carbon radical, to produce a variety of organo-silicon chlorides. After being treated with water, silanols are formed which condense with each other to build up long chain molecules as in the hardening of silicic acid gel.

Liquid Silicones

Liquid silicones were one of the first types of silicon polymers to reach commercial production. Their properties of a low change of viscosity with temperature, low freezing point, unusual chemical inertness, and stability to heat make them useful as gauge liquids, damping fluids, and as an anti-foaming agent in diesel lubricating oil, where a few parts of silicon fluid per million of diesel lubricating oil inhibits foaming more efficiently than any other material ever found. This silicone treated oil was used exclusively for submarines and aircraft during the war.

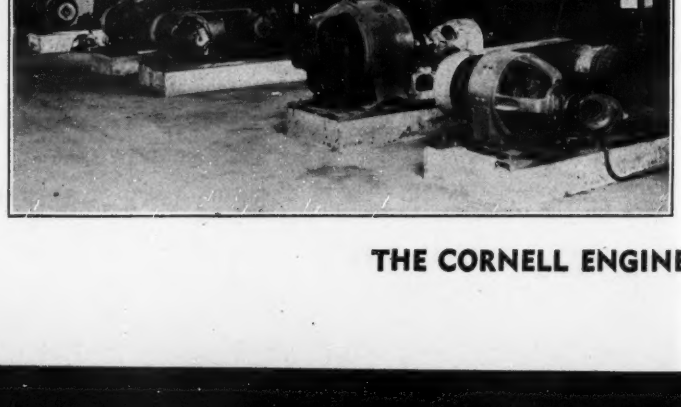
Lubricant

During a critical stage of the war, a translucent silicone grease of vaseline-like consistency made an important contribution to the success of military aircraft. This compound, stable when heated and retaining its consistency from —40 to 200 degrees C., has been developed for use as a lubricant for ignition cables, to reduce corona cutting of the insulation and permit easy wiring of ignition harnesses. Another type of silicone grease is showing stability in ball bearings several times as great as organic greases at the same temperature.

"Bouncing Putty" was the fore-

(Continued on page 42)

A number of motors undergoing a test program undertaken by Dow, Corning, and Westinghouse which demonstrated the much longer operating life at elevated temperatures of silicone insulation as compared with conventional forms of insulation.



PROFESSOR CHARLES E. O'ROURKE

ALUMNUS AND PROFESSOR . . .
HIS DEATH IS TRULY CORNELL'S LOSS

Professor Charles E. O'Rourke of the School of Civil Engineering died in the University infirmary January eleventh after a long illness.

Professor O'Rourke was one of the few men who successfully combined a teaching career with private practice. In addition to his duties as Professor of Structural Engineering he acted as structural consultant on many steel, concrete, and timber buildings and bridges. Notable among these was the much publicized reinforced-concrete flight hangar for the Curtiss-Wright Co. of Buffalo, N. Y.

"Pat" O'Rourke, as he was usually called by his friends, centered his life around civil engineering. He had the quality of "living" buildings and bridges, and of imparting the same feeling to his students, thus lifting him above the ordinary instructor into the ranks of the truly good ones. Engineering was not his whole life, however. He had a private flying license, obtained with his son while in Honolulu, and enjoyed a good game of golf when time permitted.

Born in New York City, Professor O'Rourke graduated from Stuyvesant High School and planned to study engineering at New York University. However, the day before the competitive examination for Cornell tuition scholarships, he was persuaded by a classmate to try the exam. With no preparation, but with a desire to see what a real examination looked like, he took the test and was later surprised to learn that he had won a scholarship. This cost N.Y.U. a prospective customer, gave Cornell another great student, and won him a lovely wife, for it was while attending Cornell that he met Miss Hilda Julia Mullen of Patton, Penna., a student in the Ithaca Conservatory of Music (now Ithaca College), whom he married in 1917.

While in school Professor O'Rourke joined Sigma Phi Sigma fraternity and was elected to Chi Epsilon and Tau Beta Pi, honorary engineering societies. He is also a member of Pyramid and of Gargoyle, honorary architectural society.

Graduating in 1917 from the Cornell School of Civil Engineering, he was a member of the school faculty from 1919 except for occasional leaves of absence. He became Assistant Professor in 1923 and Professor of Structural Engineering in 1934. In 1921 he was Visiting Professor of Structural Engineering at the Carnegie Institute of Technology; and during the years 1926-27 was in charge of the structural engineering department of the Imperial University at Tientsin, China. In 1941 he was Visiting Professor of Structural Engineering at the University of Hawaii, Honolulu.

In the years following his graduation, Professor O'Rourke saw more than the classroom side of engineering. He served as a second lieutenant in the army during the first World War, and from 1920 to 1928 was designer for the Concrete Steel Co. of New York City. It was in this capacity that he helped design the famous Thayer Hotel at West Point.

Since 1937 Professor O'Rourke had been consulting engineer for the Cooperative Grange League Federation. In this position he designed a large number of stores, warehouses, grain elevators, and freezer-locker plants in New York, New Jersey, and Pennsylvania. In 1938 he was a member of the Jury of Award for the $200,000 awarded by the James F. Lincoln Arc Welding Foundation and in 1944 served on a special committee to formulate rules for the 1946 textbook award program. In addition to these many activities he was engineering consultant for the American La-France-Foamite Corporation of Elmira, New York, and was in charge of a project involving the re-design of their 85 and 100 foot aerial ladders.

Combining his practical experience with theoretical studies for the benefit of new students of civil engineering, Professor O'Rourke was a Consulting Editor of the Civil Engineering Series of the International Textbook Co. of Scranton, Penna. He was also co-author of several books and was Editor-in-Chief of the "General Engineering Handbook."

Professor O'Rourke is survived by a son, Robert Edward, a daughter, Patricia Ann, and wife, Hilda.

The loss of Professor O'Rourke will not only be felt by the engineering profession as a whole, but by Cornell students who have lost one of their best and most popular professors.

Welders in Diving Suits

THIS IS THE STORY OF THE DEVELOPMENT OF UNDERWATER WELDING, WHICH AIDS SIGNIFICANTLY IN THE CONSTRUCTION AND REPAIR NOT ONLY OF SHIPS BUT OF A WIDE RANGE OF SUB-SURFACE INSTALLATIONS.

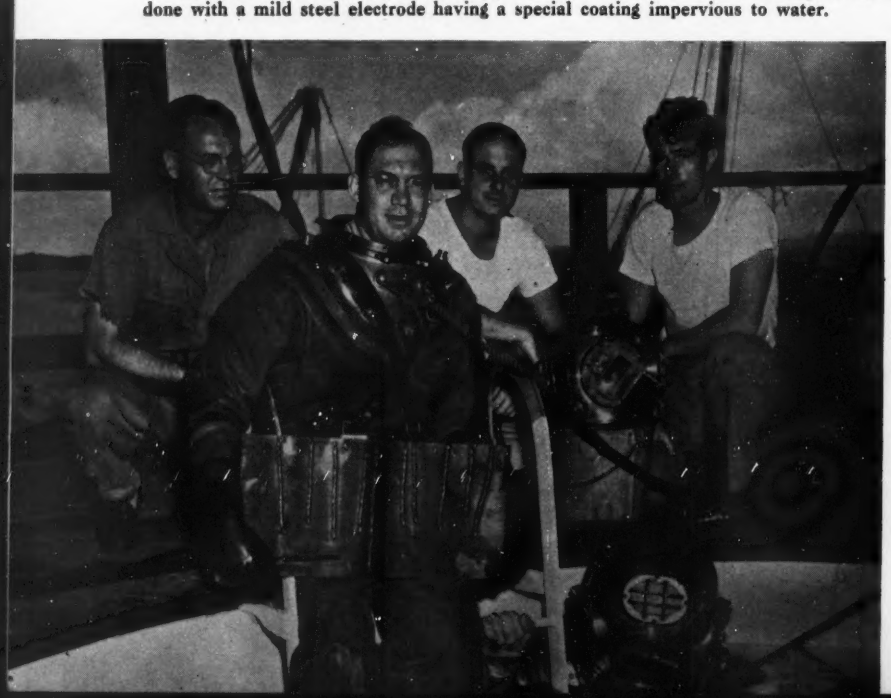
By HOWARD SANDERS, ChemE '47

All pictures couresty of the Lincoln Electric Company

The radio message was clear-cut: *Air raid on Pearl Harbor. This is no drill.* The Japanese dive bombers had droned in past Diamond Head from the southeast. Their engines were heard over Waikiki and over the bright pink facade of the Royal Hawaiian Hotel. And when the bombardiers came over the harbor, they really let those charges go. Within seconds, ships were twisting and sinking to the bottom. Nineteen vessels that day felt the thud of bombs. In slightly less than two hours, the United States Navy was sent reeling.

Yet the record of what followed after the bombing of Pearl Harbor is nothing short of brilliant. It is the story of men who forged through the oily muck and the floating debris to put those ships afloat again. Of the nine battleships that were burned or sunk, only one failed to return to active service. Three battleships were at sea in less than two weeks. With new contours and sometimes with new silhouettes, those ships which a few months before had been gaping corpses proudly rejoined the fleet. In most cases, they were better ships than they had been before they were bombed. A mammoth salvage operation had paid off—with glories besides.

A welder shows a test plate of sample welds made under water. The operation as done with a mild steel electrode having a special coating impervious to water.



The proper tribute goes not only to the salvagers who worked the man-killing hours, but to the equipment that brought speed and efficiency to their efforts. Of the host of techniques employed, nothing contributed more significantly to repairing the damage at Pearl Harbor than welding. Without it, the salvage operation would have been thwarted at the outset. Without underwater welding, in particular, the process would have been delayed for weeks, at a time when even minutes bore an untold cost.

But Pearl Harbor was only a curtain-raiser. Throughout the war—at Naples, at Cherbourg, in fact, wherever ships were wrenched by bombs and wherever torpedoes and floating mines played havoc with our armed fleet—underwater welding speeded repairs, rushed the return of ships to the fighting lines. Leakproof patches were welded over holes. Hooks and attachments were fused to the sides of ships so that they might be turned upright with speed and safety. Normally, these

vessels would have been hauled off to drydocks for long-drawn-out repairs. Not so after underwater welding became available. The job was done right on the spot—in a matter of hours. And the results were always A-1 at Lloyd's.

Fiery Arc

Underwater welding is made possible by a sizzling, metal-core electrode which burns away like a candle. The electrode and the metal slab to be welded are joined in a single electrical circuit connected to a source of high current and low voltage. With only a fraction of an inch separating the welding rod and the metal, a fiery arc bridges the gap. The heat generated by the electrical discharge is intense enough to melt the electrode and simultaneously burn a crater in the slab. Into this crater is forced the core metal of the welding rod. With his flaming electrode, a welder can join metal sections with metallic bonds capable of meeting the most exacting strength specifications.

Arc welding in the recent war built no less than thirty thousand ships of all types. Small vessels were entirely arc welded. Larger ships were 70 per cent welded. But today arc welding is not merely a builder of ships. It is also their most effective means of first aid, whether the damage takes place above or below the water line. Besides repairing damaged hulls below the surface, arc welding has lent material assistance to the erection and repair of all types of underwater structures. Steel caissons and cofferdams are remodeled. Bridges, pipes, tanks, and hydroelectric installations are repaired or rebuilt by underwater welding. Leaky rivets are sealed under water. The Panama Canal Zone Authority maintains a crew of trained underwater welders on tap at all times.

Even though for years gas torches have been useful in the underwater cutting of metals, gas has proven impractical for welding. The gas flame isn't hot enough to produce sound fusions. Hence for welding under water the electric arc is used exclusively.

As early as 1802, Sir Humphry Davy, the discoverer of chlorine gas, demonstrated that an electric arc may be discharged under water. This basic principle was subsequently put to work in the preparation of colloidal solutions of such metals as platinum, gold, and silver. But the first attempts to weld metals under water came many years later. Unfortunately, the earliest experimenters used either bare wire or thinly-coated electrodes. Their efforts failed dismally. Of necessity, underwater welding awaited the improvement of coated electrodes. But even when the proper method of arc protection had been devised, for some time it seemed as if underwater welding would remain little more than a laboratory oddity.

Here is the first successful photograph ever made of welding under water. It was taken through a porthole in the specially designed tank used for training welders in underwater operations in the Mechanical Division of the Panama Canal Zone.

Development

Although the United States Navy had been sending divers down for welding repairs as far back as 1935, it was not until World War II that underwater welding received the critical stimulus it needed. Principally through the efforts of the Navy, working in close cooperation with leading manufacturers of welding equipment, arc welding eventually emerged as a major tool in the hands of ship repairmen.

Paradox

Water, which so rapidly extinguishes lighted matches when they're dropped in fishbowls, has very little effect upon an electric arc. The reason is simple enough. Underwater welding essentially does not take place in water. The electric arc and the area of metal directly exposed to its heat are completely enclosed in a gaseous atmosphere. This gas shield consists of superheated steam and the incandescent vapors released by the electrode coating. Although Sir Humphry and the others were able to maintain electric arcs under water with bare or even the most poorly coated electrodes, these arcs were hardly stable enough to be of practical use under the far-from-ideal conditions encountered in ordinary underwater welding. Only when thicker electrode coatings were developed to provide the proper type of gas pockets did arc welding under water become feasible as an industrial process.

Coatings

Both organic-coated and metallic-oxide-coated welding rods find frequent use. During welding, the coating near the tip of the welding

(Continued on page 30)

OPPORTUNITIES FOR ENGINEERS IN INDUSTRY

. . . present industrial needs analyzed by a vice-president of G.E. . . .

By MAYNARD M. BORING

Editor's note:

This article was previously delivered here at Cornell as a speech before the American Society for Engineering Education; but because of the timeliness of this material, the CORNELL ENGINEER feels its readers will find its information of note.

The industrial opportunities for the technical graduate are probably brighter than they have ever been or will ever be again.

First, let us analyze the industrial situation from the technical manpower needs. During the roaring '20's we had a great boom in technical education, and industry clamored at the doors of the colleges for more and more men. The great development of the motor car, the expansion of the communication industry, the new field of radio, and the demand for consumer goods for the home provided an incentive that attracted large numbers to the colleges, and all found jobs in the industrial field. Public utilities absorbed many graduates. The oil industries went through a great expansion. Demands for fuel for the auto, the airplane and fuel for automatic heating demanded greatly expanded facilities and manpower so that the colleges were hard pressed to keep up with the need.

Unfortunately, much technical manpower was wasted and it became a fact that technical men were used in many places where people with other training or no formal college training could have performed almost as well.

Then came the day of reckoning when jobs were scarce and a very small number of technical graduates could find places in their field. Many had to seek employment outside their calling and have been permanently lost to the technical field. As you well know, several classes were so affected and the many engineers from the Classes 1932 through 1938, with the possible exception of the class of 1937, were lost as far as engineering is concerned. The colleges rightly kept on producing good men but their placement and usefulness was indeed inefficient.

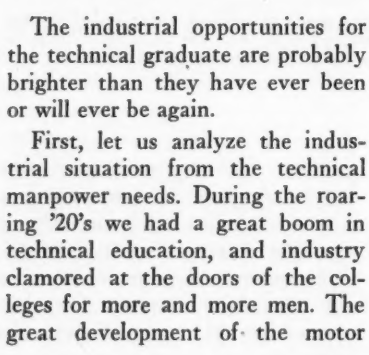
Eve of World War I

Full production came and lasted but a short time before the war and the pent-up demand for goods, after the 1932 fiasco, was little relieved in that short full-production period, as even then the demand for war goods was staggering. Then war production demands were upon us and it became impossible to fill our still active demand for peace time goods.

Following World War I we were able to quickly overcome the lack of technical manpower because the great era of technical development had hardly begun; and during that troublesome period the production of technical manpower was not impaired to any extent. Courses were almost standard and the training was broad and fundamental.

During World War II vast changes were made in our education and the colleges went all out to help win the war so that the number of graduates dwindled almost to the vanishing point, and industry was able to obtain only a very small number and, frankly, poor quality of engineering graduates. The speed-up plan was not good education as any user of technical people will agree. That kind of education is but a thin veneer poured over the immature boy, and much

THE AUTHOR



Mr. Boring

Maynard M. Boring, vice-president in charge of personnel in engineering departments for the General Electric Company, was born in Denver, Colorado in 1893, and graduated with the degree of B.S. in E.E. from the University of Colorado in 1916. He held the position of testman and assistant general foreman for General Electric from 1916 to 1922, when he was moved to the personnel department. In 1934 he was transferred to the engineering general department where he remained until 1937, when he assumed his present position. He is a member of Eta Kappa Nu, Tau Beta Pi, and Phi Kappa Tau, and holds positions on the Board of Education, Scotia, N. Y.; Board of Directors of the Y.M.C.A., Schenectady, N. Y.; and the SPEE.

"During World War II vast changes were made in our education . . . and industry was able to obtain only a small number and . . . poor quality of engineering graduates."

of it ran off without making any real lasting impression.

It is a fact that jobs change rapidly. It is my observation that changes happen in the experiences of all people as long as they are progressing so that jobs become different jobs about every five to ten years. In other words, the ladder of success for all of us has a slope determined by our abilities and other characteristics, but the rungs of these ladders are spaced about equally in time. If this is true, each space between the rungs may be considered to be a generation. Each generation then will in their time replace older groups and eventually they will be replaced by younger groups. This cycle goes on and on, and each generation is necessary to carry on our technical tradition.

Draft and War

Industry finds itself then in a most peculiar situation. First, we lost a large percentage of our generation produced in the '30's, and we have not produced a generation in the early '40's. True, many of those had their education interrupted by the war and are now returning to college. Many will eventually graduate out of phase but with unusual maturity. We must find a way of providing experience rapidly in order that this group may find a way of bridging the gap so rudely caused by the war. The continued impingement of Selective Service on us is largely preventing the high school graduate from entering the engineering colleges. This means a further delay and loss of technical manpower for several years to come.

To further complicate the problem the great depression and the war stopped the production of the skilled mechanic. The engineer may continue his developments but the lack of draftsmen to lay out designs and toolmakers to make models tends to delay production and to keep new developments from the factories. We have always depended not only on our apprentice programs to produce these vital skills, but also in the past have had a flow of such people from abroad. This flow has stopped as other countries have also stopped apprentice training during the war years.

The war period has created a tremendous advance in science and in materials. New alloys with undreamed of qualities have been developed. These must be put to use. We have learned by experience how to produce under war pressure new products that have immeasurable usefulness in our normal life.

These young men must help solve the great labor problem and educate the factory worker to the fact that only by production can we create wealth. He must become cost conscious, learn to conserve our raw material and manpower. We must have better quality and better methods of production and distribution.

Manpower Shortage

The industrial picture has a serious technical manpower shortage in the group 32 to 40 years of age. Men in these years are most productive technically. We also are faced with a greatly diminishing younger group to back them up. We have the greatest demand for goods and service in history, and we expect them to get the industrial

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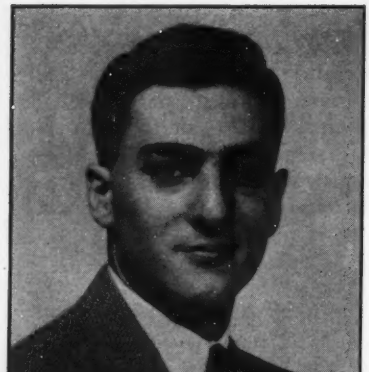
". . . There can be no ceiling for the young graduate who possesses the traits and abilities that make for success; his opportunities today are greater than he ever had or will have."

PROMINENT



Ken

Kenneth A. Kander, CE

Having trouble finding a train and timetable that will bring your girl to Cornell for Spring Week? If that's your problem, your worries are over. Just phone Kenny Kander, human encyclopedia of any and all facts covering the railroad industry. Kenny can tell you not only the shortest route, but also the best trains to take and their schedules, too.

Ken Kander was born in the Quaker city of Philadelphia on March 9, 1923. As a boy it was his ambition to become a railroad man. Rather than diminishing, this desire has increased with every passnig year. A product of Columbia High in South Orange, New Jersey, Ken entered Cornell in the fall of 1940. He soon became a member of Alpha Epsilon Pi fraternity. He joined the Railroad Club, and served as its president before enlisting in the Army in 1943. In 1942 he was elected to the business board of the Cornell Engineer, and soon became circulation manager.

Ken was sent to Camp Croft, South Carolina, for infantry basic training. After three months in ASTP he joined the 655th Topographical Engineers, attached to the Ninth Army until the end of the war. He saw service in England, France, Belgium, Holland, and Germany. Receiving his discharge in April, 1946, Ken returned to Cornell last fall. He graduated in February, but is remaining here until June taking extra railroad and traffic courses. Ken was recently elected to Chi Epsilon, honorary civil engineering fraternity.

One of Ken's chief prides is a collection of over a thousand railroad employees' timetables. These timetables differ from the ordinary passenger folders in that each one lists all operating instructions governing a defined section of track (generally about 100 miles). Ken trades timetables with people throughout the country and has a correspondence list of well over fifty.

Although Ken hates to admit it, he has never lost the thrill which comes from riding in a locomotive cab. While en route home for summer vacation a few years ago, he donned a pair of overalls and rode the cab of a Lehigh Valley special all the way from Ithaca to Newark. On looking back at that incident, however, he claims that he couldn't have become much dirtier in one of the "luxurious" coaches of the famed Black Diamond.

Carl W. Ferris, ME

If you ever heard a shill whistle and a shout for "Momo" from the steps of Sibley, you'll know that Carl was out of class looking for his faithful canine follower. Although "Momo" (one of the most prominent figures in Sibley) is classified as a stray, it can be said that she found a master after "straying" around Carl's heels for the past year.

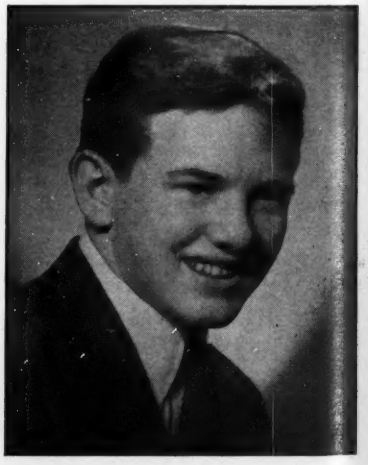
Carl was born in the thriving metropolis of Olean, New York, on March 6, 1926. After four years at Olean High, Carl appeared on the Cornell campus in November of 1943 in the form of a Navy V-12 student Anxious to participate in campus activities, he spent most of his afternoons in the Old Armory grilling on the "mats." Although often addressed by many of his friends as "canvas-back," he managed to earn two letters in wrestling and became a member of the Wrestling Club.

Week-ends found Carl at Treman and Truman as a member of Pi Beta Tau, a prominent social club for engineers, enjoying the "picnics" and occasional swims. His black hydramatic was found to serve well as transportation for—"picnic supplies." He soon showed his social abilities by becoming an officer in this organization. His presence was felt on the student council and as president of his class on several occasions. An active of Sigma Nu fraternity, Carl is a member of Atmos, honorary society in mechanical engineering. He was president of that society before his graduation.

Carl received his Bachelor of Mechanical Engineering degree in February. He was on hand for the first big Junior Week since the war. With four days of parties and an equal length of time for recuperation, Carl was ready to put to use his knowledge gained at Cornell.

Carl insists he spent most of January at the Personal Employment Office in Sibley taking in interviews. His future plans rest with a certain Tri-Delt and the DuPont Company of Wilmington, Delaware. May his plans be successful.

Carl



ENGINEERS

David G. Hollister, EE

Dave was a senior in the electrical engineering school this year. But back in 1943 when Dave entered Cornell as a freshman, the choice of schools was quite a problem. His father was a civil engineer and his older brother an electrical engineer. After many arguments both pro and con, Dave decided to string along with EE. And today he is very happy about that selection. He graduated in February and is now studying for a Ph.D. which will take an additional three years. A job in developmental research in industry is his ultimate goal.

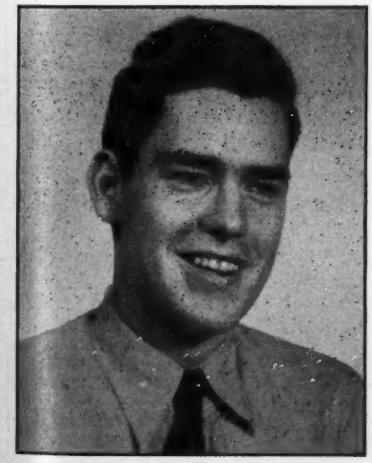
Dave was born a Pennsylvanian, but considers Ithaca his home town, having lived here for the past fourteen years. Planning to enter Phillips Academy, he decided to complete his high school training in Ithaca. This enabled him to graduate at the earliest moment and to enter Cornell in February of 1943. Rushing ushered Dave into the midst of campus life. Alpha Delta Phi was his choice of fraternities. The campus was turning military about the time that Dave was stumbling over Newton's three laws of motion. Dave became a cog in the wheel of Navy V-12's in the fall of '43. A long grind of marching, studying, rowing on the crew, and dating a certain young lady resulted in his being commissioned in the fall of '45, three weeks after marrying "a certain young lady" in Sage Chapel.

Dave enjoyed fourteen days of sunshine in California before shoving off for parts unknown. He picked his ship up at Guam and subsequently served as communications officer and then executive officer on the PC 1137. Working with all kinds of electronic equipment promoted the idea of trying for a Ph.D. when he got back to Cornell. After a winter in the South Seas, Dave returned to the hill where he began his final term this fall.

Dave was a rabid model railroad fan before the war. He was a member of the now defunct Cornell Railroad Club which operated a realistic network of track in the basement of the Hollister home. The "Cornell and Cayuga Railroad" was disbanded shortly after the war began and is now stored in Olin Hall.

Dave has spent many a summer sailing on blue Cayuga and Lake Michigan. In 1942, manning a thirty-foot sloop, Dave and his uncle captured first place in a race from Muskegon, Michigan, to Milwaukee, wisconsin. When winter rolls around Dave has his skis waxed and shining for taking the slopes at Virgil. Photography is an up and coming hobby for Dave this year. He has taken a number of still life pictures and with the aid of enlarging equipment has turned out some very fine results.

Dave Hollister



David Esperson, ME

Dave is one of the many Cornellians who, after an absence of a few years, resumed his course of study at Cornell. Dave was first seen on the hill in the fall of '40, coming directly from Phillips Academy, a prep school in Andover, Massachusetts. His two years there had been a "grind," with not much time off for basketball, his favorite sport. It didn't take long for Dave to get into the swing of things at Cornell. He was elected to the business board of the Cornell Engineer his sophomore year. For doing such a fine job, the post of business manager was his for the following year. A taste for the better things in life resulted in his becoming a Kappa Beta Phi in '41. His junior year was highlighted by joining Atmos and becoming a member of Tau Beta Pi, honor society for engineers.

Dave Esperson

Having completed seven terms in three years, the call from the Army was heard. Dave had been taking advanced ROTC so was sent to OCS at Fort Sill, Oklahoma. Three months later a second lieutenant, Dave took flight training and became a liaison pilot in the field artillery. He arrived in the ETO in the summer of '44 and served with the Seventh Army. "The cognac was excellent" sums up the two month's period following VE day. In October, 1945, Dave went to Biarritz, France, to attend the American University where he took various electrical engineering courses for two months. It was home again in June, 1946.

France was not foreign to Dave. Although born in Brooklyn on March 13, 1923, he moved to Paris, France, the following year where his father was European director of the William R. Warner Co. Able to speak French even before learning English, Dave attended American schools in Paris until coming

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Recent Developments In Engineering

Techni-Briefs

Rust and Corrosion

One of the primary questions facing metallurgists, chemists, and other research scientists is: what actually happens in the invisible boundary that is formed when any solid reacts with any gas? Aimed at providing better tin plate, cheaper stainless steel, stronger gas-turbine blading, and longer wearing bearings for engines, investigations are being made of the oxides that form on metals. The three tools used for this purpose are the electron microscope which describes the coating physically, the electron diffraction camera which reveals its chemical nature, and the vacuum microbalance which measures the rate at which the coating grows.

By means of the electron microscope the film of atoms so minute that six billion of them would weigh little more than an ounce is magnified 50,000 times. A high voltage stream of electrons is passed through the sample and pulled outward by magnetic fields along the sides of the microscope. The magnified image, produced by two successive spreadings of the beam, is recorded on a strip of photographic film in the form of a shadowgraph.

The diffraction camera directs an electron beam at an angle to the sample so that it ricochets off and strikes against a strip of photographic paper. This results in a pattern of black and white semicircles that are formed by the electrons bouncing off the different faces of the block-like molecules of the oxide coating. By measuring the distance between the rings, the scientist is able to determine the chemical nature of the oxide.

The vacuum microbalance is a highly sensitive instrument constructed mainly of quartz and hair-like tungsten wire, and enclosed in a vacuum chamber. The sample is hung from one end of the balance beam, while a counter weight is suspended from the other. A small amount of oxygen is then admitted. The movement of the balance beam is watched through a microscope and changes in weight recorded every few minutes—usually in millionths of a gram.

Because air affects metals differently at different temperatures, tests are conducted over a wide range of temperature conditions. Very low temperatures are obtained by immersing the sample in liquid air, while an electric furnace is used to reach very high temperatures.

If scientists succeed in determining the exact nature of this coating and how to control it, the trial and error method will be eliminated and the production of alloys will become an exact science.

The electron diffraction high temperature camera used to determine the chemical nature of metallic oxidies.
—Courtesy Westinghouse

New Midget Control Crystal

With numerous new television stations about to enter the already crowded radio channels, it has become increasingly important to control all sources of interference. For this purpose a new midget quartz crystal oscillator, developed by the North American Philips Company, is now being used which regulates the frequency of dielectric heating and similar installations.

This tiny crystal assembly, measuring less than ⅜ inches in diameter and less than 1¼ inches in length, is mounted in much the same way as a radio resistor. Located at each end is a pin type terminal which is tinned so that soldering it into the circuit requires a minimum of time.

The frequency of the midget crystal oscillator is fixed to coincide with values assigned by the FCC for dielectric heating apparatus.

Trivision

Recently production was begun by the Bausch and Lomb Optical Company of a large, fast, Balcoted lens for the new three dimensional photographic process known as Trivision. Pictures taken with this process have an amazing, true-to-life depth. Moreover, they are taken with a single lens and do not require the use of viewing glasses to bring out the depth. One main factor in the process is the large diameter of the lens. It is a 14½ in., f:2.2 portrait type lens measuring eight inches in diameter when mounted. The inventor, Douglas F. Winnek, claims that a camera lens, like the human eye, can see partly around any object. Thus the wider the lens, the better the depth of

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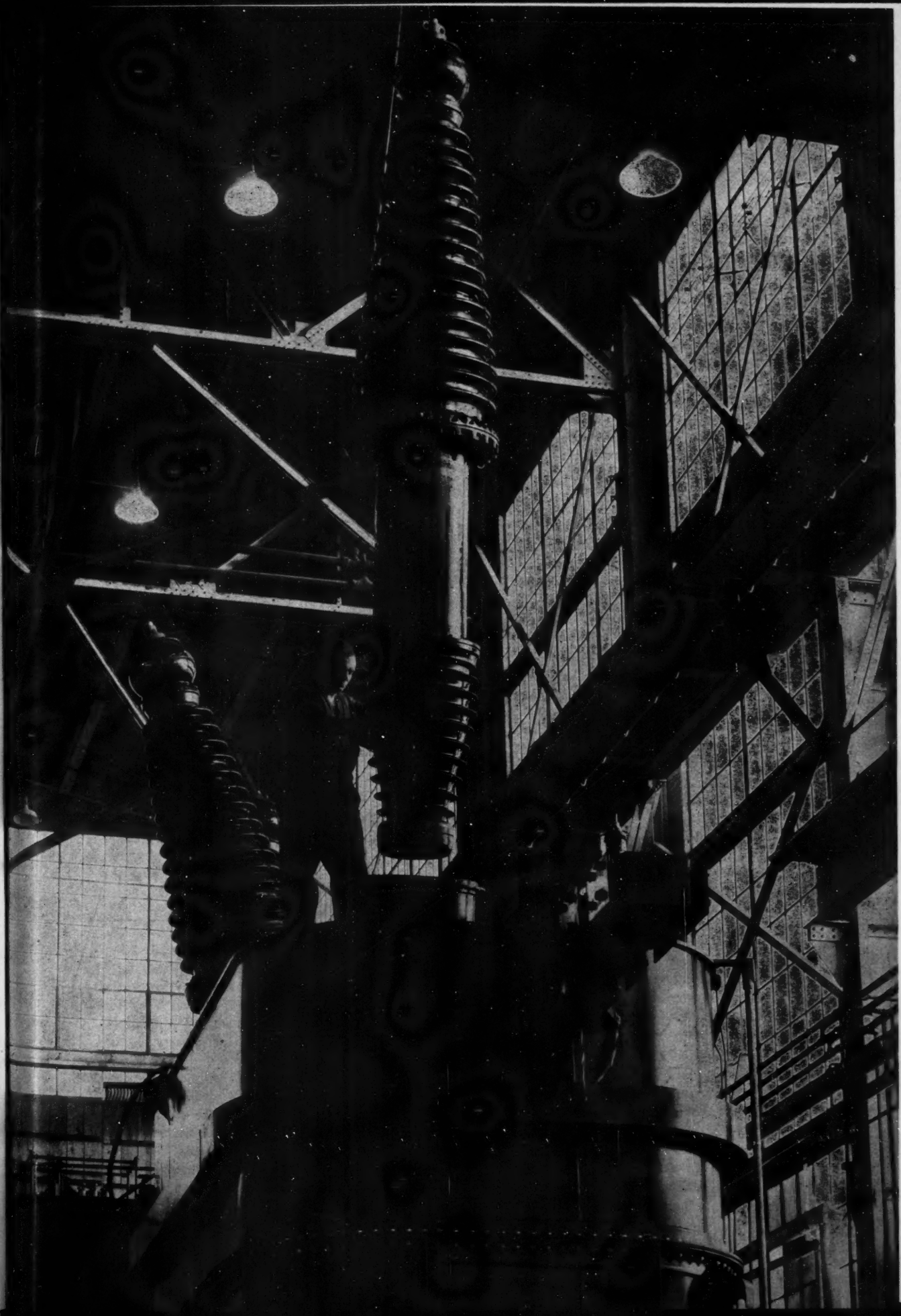
GIANT BUSHING FOR TRANSFORMER

A General Electric 196,000-volt oil-filled bushing being installed in large power transformer in Pittsfield, Mass.
—Courtesy G.E.



News of the College

Assistant Professor

Thomas J. Baird has been promoted to assistant professor of engineering drawing. Professor Baird was engaged in private practice of architecture and landscape architecture for 12 years after receiving the Bachelor of Architecture degree from Cornell in 1927. He returned to the University in 1939 as instructor in floriculture and ornamental horticulture, later becoming instructor in engineering drawing. He received the degree of Master in Regional Planning at Cornell in 1945. He has had numerous articles published in magazines and journals, including a story with pictures of his home at McKinney's Point in a recent issue of *American Home* magazine.

Pepsi-Cola Winners

Three Pepsi-Cola scholarship winners have entered the College of Engineering. William G. Jennings of Evanston, Illinois is a student in the Sibley School. Victor K. Pare of Collingswood, New Jersey and Lloyd L. Gray of Douglaston are enrolled in the School of Electrical Engineering.

Winners of Pepsi-Cola Scholarships are selected from each state by a special board of educators. Candidates must be voted by their senior classes in high schools as those "most likely to make an important contribution to human progress." They take a written aptitude test prepared by the College Entrance Examination Board and, from the twelve contestants in each state who score the highest on this test, the Pepsi-Cola Scholarship Board selects two winners. They receive all tuition and fees and $25 a month for four college years and travel expense for one round trip a year between home and college.

Grumman Winners

Four Engineering students hold scholarships provided by the Grumman Aircraft Engineering Corporation. They are Thomas J. Kelly of Merrick, M. Alan Kopsco of Valley Stream, Robert Nafis of Lynbrook, and John C. Snedeker of Babylon. Kelly and Kopsco are freshmen who received their scholarships just this fall. All four are Long Islanders, since the scholarship reads "to encourage talented and ambitious graduates of Long Island schools to enter the field of aircraft engineering, and eventually to further the development of aviation on Long Island."

The Grumman Corporation, of which Cornellian Leroy R. Grumman is chairman of the board and Cornellian Leon A. Swirbul is president, pays tuition and fees for the entire college course.

Burrell Fund

The "Edward P. Burrell '98 Scholarship Fund in Engineering" has just been established by a bequest of $140,000 from the late Mrs. Katherine Ward Burrell of Cleveland. Mrs. Burrell established the scholarship in memory of her husband who died in 1937. Burrell, who received the ME(EE) in 1898 and the MME in 1899, was director of engineering for Warner and Swazey Co. in Cleveland.

Fourth Dimension

Dr. Vladimir Karapetoff, Professor Emeritus of Engineering, Cornell, gave a talk on the fourth dimension the first of the year after the annual "Kary" (Karapetoff) dinner of the New York Alumni Chapter of Eta Kappa Nu Association. Dr. Karapetoff is an honorary member of Eta Kappa Nu. His talk was popular and non-mathematical, and illustrated with sketches. A model was also shown of the simplest possible body in the four-dimensional world, projected into our three-dimensional world. Another model showed the transformation of one chemical compound into another, by turning its molecules over in the fourth dimension.

The speaker asked his audience to imagine two-dimensional beings living in a horizontal plane and unable to move away from it or even to imagine the directions up and down from this plane. He then showed how an ordinary human being would seem supernatural to the inhabitants of such a two-dimensional world.

Dr. Karapetoff then pointed out that our difficulties in "visualizing" the fourth dimension are akin to those of the "flatheads" trying to visualize our third dimension. The simplest body in our world is a triangular pyramid, or tetrahedron, with four vertices, six straight-line edges, and four plane triangular sides. The simplest body in the four-dimensional world has five vertices. These vertices may be connected in pairs by ten lines, so that the super-tetrahedron in the four-dimensional world has five vertices. These vertices may be connected in pairs by ten edges. It also has ten plane sides. A remarkable feature of such a body is that it has five three-dimensional tetrahedrons for its boundaries. The speaker demonstrated such tetrahedrons and explained that only one of them was in our world, the remaining four "sticking out" into the fourth dimension.

Gage Conference

Roger L. Geer, assistant professor of materials processing at Cornell, spoke on "The Services of the University Ordnance Gage Laboratory to Industry," at a two-day Industry Ordnance Gage Conference at Lehigh University, Bethlehem, Pa., February 13-14. The conference was sponsored by the Gage Division of the Army Ordnance Association.

Geer, presently acting director of materials and processing in the

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Out of Phase

By HERBERT F. SPIRER, EP '51

After decades of waving arms, making isometric drawings and deriving Bissel functions in a vain effort to describe the torus, a harrassed faculty has found relief. Mr. Jahn, noted instructor of the calculus, stated with profundity to his freshman engineers, "The elusive torus, gentlemen, is no more than . . . than a . . . than a bagle!"* We will continue to read Li'l Abner with scholarly eagerness . . . With the torus conquered, we can only wonder, "What next, Mammy Yokum, what next . . . Icosahedrons?"

Science:

Gregory, the little man with the lavender ears, would like to present a theory to replace the Electron Theory, his pet hate. "After years of experimental observation in accordance with the strict teachings laid down by Professor Wood," writes Gregory in the *Sibley Journal of Applied Depravity*, "I have come to the conclusion that this earth of ours is no more than a positively charged particle (and weakly charged, at that) in the nucleus of an atom in a molecule (not a very big molecule, either) in a cell in a wart on the middle toe of a polydigital myopic dwarf in some other, no doubt, equally malevolent, universe." How does this Dwarf-Wart Theorem sound to you, Engineer of Tomorrow?

Sale of the Month:

Is your slide rule up to par? Do you see spots instead of the A-scale on the morning after? Hmm? Does your slider jam when you want to make a good impression? Do you have H.H.? (Haggard Hairline)? Does the space between numbers grow smaller as the numbers grow larger? Do you find it difficult to read the time of day on the LogLog scales?

Engineers . . . put an end to your misery! Try the new Zig-Zag twelve-foot vest-pocket slide rule. No slider, no runner, no moving parts, and no hard-to-read scales. Unconditionally guaranteed to be inaccurate to three places. This slide rule cannot be bought from any newsboy, from any bookstore, and will never become a bargain item at the Coop. However, this slipstick is given free, absolutely free, with every lifetime subscription to the *Engineer* . . . Don't push, Miss McCleod, there is enough to go around.

* * *

LOST: One brown morocco cashbox, via the Dutch, finder keep pictures, receipts and letters. Please return cash, has sentimental value. Eunice Blmph, 13 Scraggly Hall.

* * *

A grave digger, absorbed in his thoughts, dug a grave so deep he couldn't get out. As the chilly night came on he became more and more uncomfortable, and started shouting for help.

Finally, a passing drunk on his way home from Jim's, attracted by the cries, staggered over to investigate.

"Get me out of here," shouted the grave digger. "I'm cold."

The drunk regarded him with surprise. "No wonder you're cold," he answered, "they forgot to put any dirt on you."

—*Radcliffe Engineer*

* * *

The Home Ec Soph milked the pensive goat
And pouting paused to mutter,
"I wish you brute, you'd turn to milk."
Instead the nanny turned to butt her.

—*Miasma*

LACAOON AND THE SNAKES, AS SEEN AT LINCOLN ___.

*The Out-of-Phase Museum of Advanced Engineering Techniques will have a petrified bagle on exhibition throughout this month. The public is invited.

Cornell Society of Engineers

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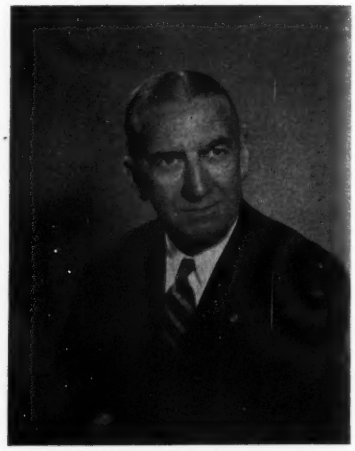


"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

This happens to be the month during which certain economists believe that we will start on a "corrective recession." We are a very mercurial nation, so that in a little while thousands may be jittery and others grumbling that we are going to the dogs, and that the chance of real prosperity has faded or that we are in for a big bust without ever having enjoyed a postwar boom, thanks to the way Labor has kept everything in a turmoil. But some of the economists I have talked with don't believe that the recession, if and when it comes, is going to be a deep and lasting one.

I had the privilege recently of attending a meeting where representatives of labor, management, farmers, veterans and bankers sat down in a true spirit of cooperation to widen our areas of understanding and agreement and to get a better perspective of each other's problems, and thus be able to do more positive good in this troubled world of ours. What interested me particularly, from the standpoint of engineering, were the following statements by an investment banker. I quote them because I think they are so true. He said:

"We are in the midst of a dynamic revolution in industrial technology. The rate of technological change in industry has increased until it is, in my view, the most important economic fact of life for us today . . .

"Few of us realize the opportunity for expansion which these amazing developments offer to the economy as a whole. It is, in my opinion, not too much to say that we stand on the edge of one of the most glorious periods of man's struggle to increase his economic well-being. The scientific laboratories of our universities and of our industries have supplied us with a wealth of new methods, materials and machines capable of providing a solid basis for a new period of economic progress. What I want to convey to you is an idea of the sheer weight and compelling force involved, for science has prepared the way for a new adventure in conquering want and raising the standard of living to levels undreamed of even in this land of productive achievement."

He went on to give a few of the items now available, which are too numerous to give in detail although extremely fascinating. Briefly, the fields he covered were: electronics—cheaper means for tempering, bonding and sewing metals and other materials, and new means for increasing the safety factor in air, land and sea transportation; discoveries in powder metallurgy which are creating revolution in the metal working industry with porous self-lubricating bearings and machine tools of incredible hardness; in housing—packaged kitchens and bathrooms, more efficient and compact heating devices, new insulating materials and those things which will extend the life of housing and eventually lower its cost. He thinks we face a fantastic transformation in the ancient industry of agriculture, with a wealth of new farm machines for planting pelletted seeds with built-in insecticides, fungicides and fertilizers. He concluded:

"The facts of technology make a shambles of all the silly talk of economic maturity we have heard from the die-hard pessimists . . . We have many years of intensive development ahead and our new scientific frontier pales into relative insignificance the geographical frontier of the past. How ridiculous it is to talk of over-saving and under-investment when industry is faced with the potentialities of expansion inherent in the technology of the present."

So, engineers and scientists should feel gratified in the fact that your work is now being recognized as playing an important part in the economic hope of the future.

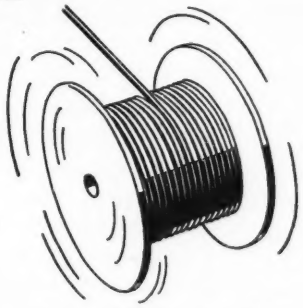
ROBERT B. LEA

NUMBER 6 OF A SERIES

Newsworthy Notes for Engineers

What is CV?

CV is the answer to a tough problem. It stands for Continuous Vulcanization—a process developed by Western Electric engineers to speed-up and improve production of rubber-insulated telephone wire. It proved so efficient a process that more than thirty outside manufacturers have introduced CV into *their* plants.



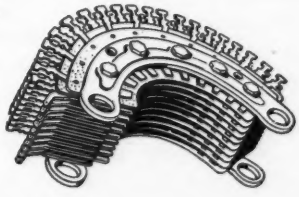
Under previous methods, the rubber compound was fed by hand into a forcing or tubing machine which extruded it upon the wire. The conductor with this unvulcanized covering was coiled in pans in a layer of powdered soapstone and sifted chalk, with each flat coil separated from its neighbor by another layer of soapstone and chalk. The insulated wire in the soapstone and pan was afterwards placed in a steam vulcanizing oven and cured for approximately 45 minutes. An additional reeling or coiling operation was required and the complete process took from one to three hours depending on the insulation wall thickness.

Now the continuous insulating and vulcanizing machine—developed and built by Western Electric engineers—does the whole job in one operation. Rubber compound and bare wire are both fed continuously into one end of the machine and then through steam at high pressure which cures the rubber insulation in approximately 7 seconds. The insulated wire is taken up on reels in continuous lengths up to 30,000 feet in a fraction of the time required under the old panning process.

Halving the steps on Step-by-Step

Simplifying production of over 1,000,000 Step-by-Step "banks" per year—for use in dial telephone exchanges—gave Western Electric engineers an interesting assignment.

One of several types of "banks" consists of 200 brass terminals, assembled in 10 levels, the terminals of each level accurately positioned on a crescent shaped phenol fibre insulator which separates them from the next level. The entire assembly occupies a space of but 4½" x 2½" x 1½". Initially, banks were made in ten steps: (1) spray varnish on phenol fibre strips; (2) punch insulators from these strips; (3) punch *individual* terminals from coils of brass sheet; (4) assemble a preliminary pileup, picking up each terminal by hand,—200,000,000 per year, and accurately positioning it on the varnished insulator; (5) bake; (6) compress to secure terminals to varnished surface of insulators and then dismantle preliminary pileup; (7) make final assembly, inserting additional insulators and spacers; (8) bake; (9) compress and tighten clamping screws; (10) cut off excess length of screws and line ream mounting holes.



Western Electric engineers streamlined these ten steps into five: (1) punch insulators from *unvarnished* phenol fibre strips; (2) punch terminals, leaving them connected to each other, and wind into rolls; (3) automatically separate terminals from roll and eyelet to insulators in punch press equipped with dial feed tools; (4) make final bank assembly; (5) compress and tighten clamping screws.

Results—a 30% reduction in manufacturing cost, an improvement in quality, and more economical utilization of manpower and facilities.

Manufacturing telephone and radio apparatus for the Bell System is Western Electric's primary job. It calls for engineers of many kinds — electrical, mechanical, industrial, chemical, metallurgical — who devise and improve machines and processes for large scale production of highest quality communications equipment.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Alumni News

Upon his retirement from the Corps of Engineers, **Colonel Roy D. Burdick, C.E. '14,** announced his return to practice as a Consulting Engineer. His office is at 512 Exchange Building, Little Rock, Arkansas.

Alexander M. Beebee, M.E. '15, has been elected president of the Rochester Gas and Electric Corporation. He has been vice-president of the firm since 1945, and was general superintendent of the gas division for eighteen years before that. Mr. Beebee joined the company in 1916 and became a director in 1943. During the war, he headed the so-called "Baruch committee of the gas industry" to map out blueprints for post-war action in the gas field.

John Haydock, Jr., M.E. '17, has been appointed editor of Design News. He was formerly executive editor of American Machinist.

Leon A. Swirbul, M.E. '20, was elected president of Grumman Aircraft Engineering Corporation in July to succeed Leroy R. Grumman, '16, who became chairman of the board, a new post. Swirbul has been executive vice-president of the company, which was founded by Swirbul, Grumman, and William T. Schwendler in 1930. Both Grumman and Swirbul have received the Medal of Merit from President Truman for record-breaking production of fighter planes for the Navy.

Carl F. Ostergren, M.E. '21, has transferred from the New York Telephone Company to the American Telephone and Telegraph Company as assistant vice-president. More recently, he has been employed by the Western Electric Company in New York as patent license manager. Mr. Ostergren has been executive vice-president of the Cornell Society of Engineers.

Professor William L. Everitt, E.E. '22, head of the University of Illinois Electrical Engineering department, has received the exceptional civilian service award for his work as director of the operational research staff of the chief signal officer from 1942 until the end of the war. The award was presented by Brigadier General C. H. Arnold of the office of Chief Signal Officer, USA, at a dinner held on the Illinois campus on May 28. Professor Everitt's special contributions were new methods and procedures for improving Signal Corps equipment, institutional literature, and improvements in the technician training program, resulting in better utilization of radar equipment.

Leonard B. Richards, M.E. '26, became president of the Harrisburg (Pennsylvania) Gas Company on January 1 of last year. He was formerly president of the Nashville (Tennessee) Gas and Heating Company.

Daniel M. Coppin, C.E. '27, has been elected vice-president and a director of the Fisher-De Vore Construction Company, Cincinnati, Ohio.

Walt Hardy, Ch.E. '38, is general manager of the Protective Coatings Corporation in Belleville, New Jersey. His mailing address is: 386 Upper Mountain Avenue, Upper Montclair, New Jersey.

Dav Thomas, M.S. '39, is Executive Vice President of the Arcos Corporation, Philadelphia, Pa.

Ralph (Butch) Vreeland, Ch.E. '39, is with the New Jersey Zinc Company in New York City.

Dick Smith, B.S. in Ch.E. '43, is with Kay-Fries Chemicals, Inc., in West Haverstraw, New York.

Austen Boyd, B.Ch.E. '43, is with General Electric in Schenectady.

Lou Mead, B.Ch.E. '43, is with Carbide and Carbon Chemical Co. in Oak Ridge, Tennessee.

Robert A. Moore, Chem.E. '43, is now associated with the Sun Oil Co. at their Bayonne, New Jersey plant.

William E. Barr, M.E. '44, is diesel engineer at the Big Spring, Texas plant of the Humble Oil Co.

Jim Scovic, B.Ch.E. '44, is in Midland, Michigan with Dow Chemical Co.

E. J. ("Tug") Tolle, B.Ch.E. '44, is now working for the Ozalid Corporation. His home is in Harpursville, New York.

Wil Kranich, Ph.D. '44, is now at Princeton University as an assistant professor in Chemical Engineering.

Al Baker, B.Ch.E. '44, is with Sun Oil Company at Marcus Hook, Pa. His home address is: 231 Valley Road, Merion, Pa.

George DeLaMater, B.Ch.E. '44, is doing graduate work at Harvard.

Dave MacLean, B.S. in Ch.E. '44, is with Allied Food Industries, Inc., Perth Amboy, New Jersey.

Frank Dittman, Ph.D. '45, is with the Koppers Company, Inc., in Pittsburgh, Pa.

Pete Lantos, B.Ch.E. '45, is with General Electric in Pittsfield, Mass.

GOODBYE CONFUSION

The spectacle of the bewildered stranger, tangled in the coils of dozens of incoherent street maps and squinting at illegible street signs is disappearing from the American scene. Richard R. Lymon, M.C.E. '03, Ph.D. '05, consulting civil engineer of 1084 East 150 North Street, Salt Lake City, Utah, has developed a new method of designating streets that promises to make any city an open book to strangers. The Sons of the Utah Pioneers, a group quite active in civic affairs, has effected the adoption of the new plan throughout the state of Utah. The complete "renaming" of all streets in Utah will be completed by July 24, 1947, the date of Utah's Centennial Celebration.

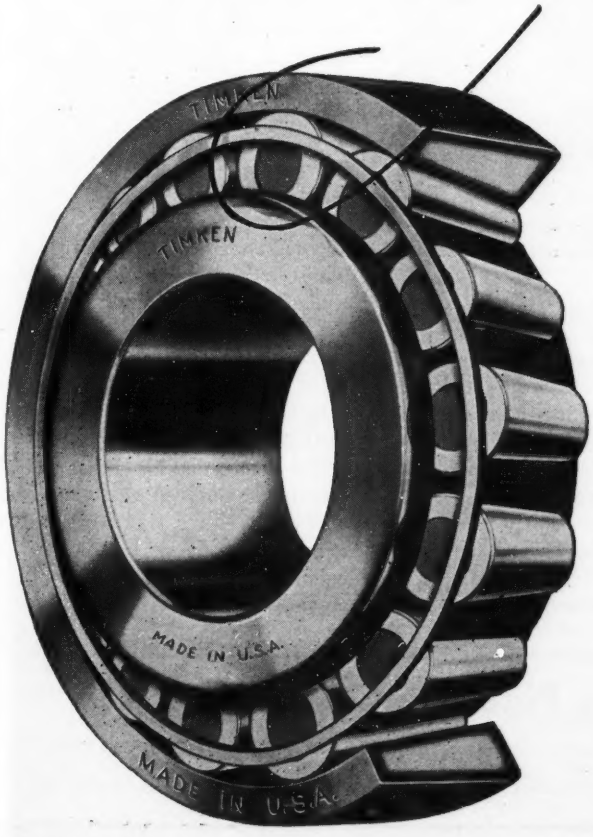
(Continued on page 42)

A BEARING QUIZ FOR STUDENT ENGINEERS

Do you know that over 90% of all modern bearing requirements can be met adequately with the Timken Tapered Roller Bearing? That in this one precision mechanism is contained a multiplicity of abilities which when fully appreciated and properly applied can overcome any bearing condition you ever may encounter?

Do you know that the Timken Roller Bearing is more than an anti-friction bearing; more than a radial load bearing? That it is an all-load bearing — can carry, all at once, radial loads, thrust loads, and any combination of them with full efficiency and certainty?

Do you know that the Timken Bearing was introduced nearly 50 years ago and has undergone constant engineering development and refinement ever since? That the Timken-developed process of Generated Unit Assembly produces true spherical (convex-concave) contact between the large ends of the rolls and the rib or flange of the cone thereby reducing friction and initial wear to a minimum; assuring correct alignment of the rolls with respect to the races; helping to distribute the loads evenly throughout the bearing; decreasing operating temperatures; producing quieter running; and last, but not least, assuring that when the bearing is properly mounted no further adjustment is required?



Do you know that the special alloy steel from which Timken Bearings are made was developed in our own metallurgical laboratories and is produced in our own steel plant? That the Timken Bearing is the only bearing manufactured under one roof from raw material to finished product?

Would you like to know more about the Timken Bearing, particularly how it can help you in your engineering career? Write us. The Timken Roller Bearing Company, Canton 6, Ohio.

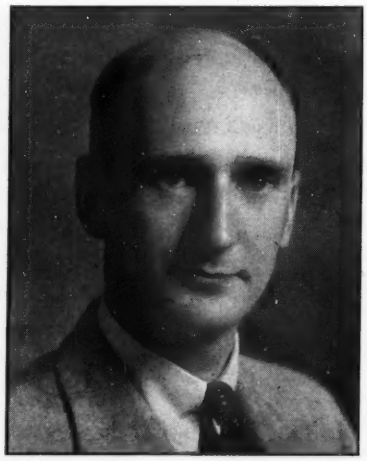
JAMES NORMAN GOODIER

FIRST WINNER OF THE WESTINGHOUSE AWARD FOR NOTABLE CONTRIBUTIONS IN ENGINEERING TEACHING IS CORNELL'S HEAD OF THE M.E. DEPARTMENT OF MECHANICS AND MACHINE DESIGN.

Last June, the Society for the Promotion of Engineering Education presented James Norman Goodier of Cornell University with the first annual $1000 George Westinghouse Award in Engineering Education. Sponsored by the Westinghouse Educational Foundation, the award is granted for distinguished contributions to the teaching of Engineering students. Professor Goodier, Head of the Departments of Mechanics and Machine Design in the School of Mechanical Engineering, is well qualified to be the first recipient of this honor; not only is he a scientist in his own right, but he is also a true educator. In his work with his students, he has broadened the scope of sound engineering instruction, and has passed on to them something of his own spirit of pioneering achievement and his high standards of excellence.

His profound knowledge of and interest in his teaching material make his courses "come alive" for the students, since he teaches in terms of basic principles, without disassociating engineering practice from general concepts of living. "It is merely a matter of a grasp of abstract ideas and the basic principles or concepts of the subject," he says. If you have a complete understanding of the basic concepts, the rest follows without difficulty.

"Students tend to resist these abstract principles because they are inclined to be impatient; they almost always have the urge to get to something which is recognizably practical in the immediate future. These basic ideas, however, cannot be absorbed in a matter of days or weeks, but must require a considerable amount of meditation and concentration. Therefore, I attempt to excite their interest in the abstract ideas by illustrating their unifying influence, and showing how they apply in all fields of knowledge."



Professor Goodier himself shows interest in many activities. He has traveled extensively, especially through the United States, and feels that traveling affords a broader appreciation of problems which, under ordinary circumstances, would naturally be taken for granted. He has not devoted himself completely to his science, as he feels that lack of interest in other fields results in an unbalanced personality. In teaching, Professor Goodier exemplifies this attitude, pointing out that it is not any special approach that makes a good teacher, but a feeling for the subject as a whole. Besides complete knowledge of his work, the teacher must have a fundamental interest in his work and his students.

Born in England, Professor Goodier received his preliminary education at Cambridge University, studying physics, mathematics, and mechanical sciences. While at Cambridge, he was engaged in detailed research on bridge construction, studying with Professor C. E. Inglis. After completing his studies in England, he was awarded the Commonwealth Fund Fellowship in 1929, and studied at the University of Michigan, receiving his Doctor of Science degree in 1931.

Doctor Goodier then became a research fellow at the Ontario Research Foundation, continuing his work there until 1938, when he was appointed to the staff of Cornell University. During the war, he administered special courses in stress analysis and elastic stability to clases at the Bell Aircraft Corporation and the Curtiss-Wright Airplane Division in Buffalo, and directed research work on aeronautical projects at Cornell.

The inspiration his efforts and his example have given to students and co-workers alike have made him a prominent figure in the field of engineering education as well as engineering.

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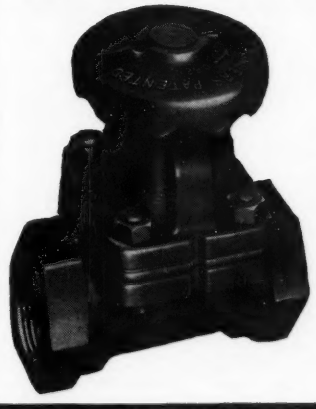

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WHENEVER **PIPING** IS INVOLVED

Book Reviews

JOB EVALUATION, Forrest Johnson, Robert Boise and Dudley Pratt. John Wiley & Sons, Inc., New York, 1946. $3.75.

Job evaluation as presented by Johnson, Boise and Dudley should be found of value to persons contemplating the establishment of a job evaluating system in a plant. Rather detailed procedures are given for the organization of the job-evaluation department and committee, determining evaluation factors, methods of selecting and studying key jobs, proportioning key jobs to evaluation factors, and defining factor degrees and labor grades. Emphasis is placed on job evaluations and their relation to money-wage rate questions.

The authors only briefly touch on the numerous places in a plant where job evaluation can be used such as in the conduct of training programs, operation of personnel office; making of costs analysis, and improving supervision.

Illustrations are used throughout to show procedures and duties in connection with the establishment of a job evaluation department. Several examples of job evaluation are presented including job descriptions and analysis of factors. Consideration is also given to the important problems of appeal procedures and recognition of individual merit.

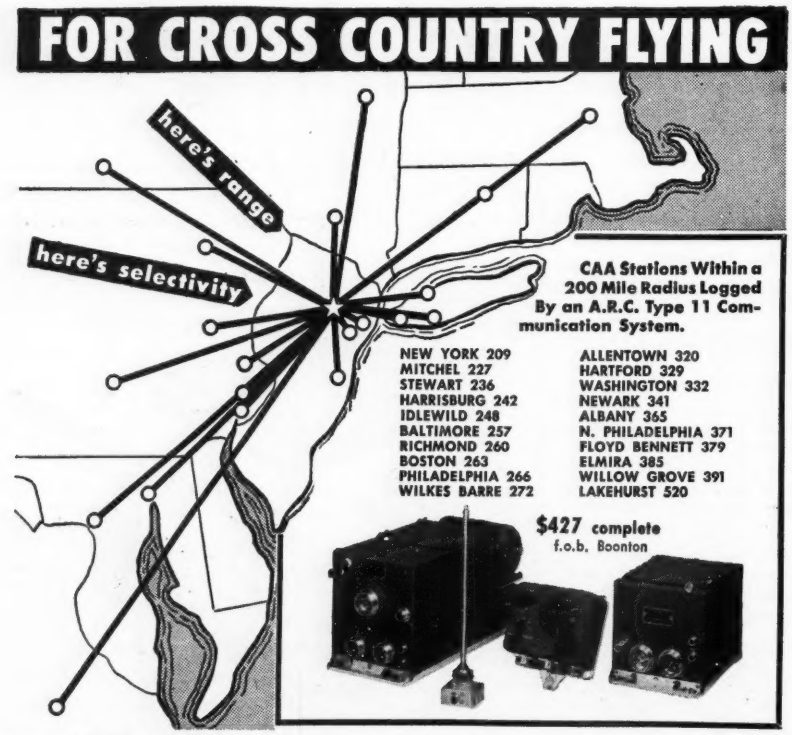
In conclusion, it is pointed out that job analysis is not the answer to all problems between employer and employee. Job-evaluation techniques are not in the true sense of the term scientific but are recognized as systematic and are pointing toward more scientific procedures in the future.

C. Kenneth Beach
Prof. Industrial Education

* * *

AN INTRODUCTION TO THE CHEMISTRY OF THE SILICONES. Eugene G. Rochow. $\times$ + 137 *pages. John Wiley and Sons, Inc. New York,* 1946. *Price* $2.75.

This timely introduction to the chemistry of the silicones was written by an alumnus of the Graduate School of Cornell University in a straightforward manner, but with a personalized style. The material is well organized as a survey of the general methods of preparation and of the properties of a variety of compounds of silicon. The author started with the element, its hydrides, halides, esters and ethers, in the first chapter, discussed the organosilicon monomers in the second, and devoted the following sixty pages to the organosilicon polymers. In the remaining twenty pages he briefly outlined analytical procedures, and included an extensive glossary and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Compare your present radio with the new A.R.C. Type 11 System. Units of the Type 11 have been designed to meet CAA requirements for Approved Type Certification. Now radio equipment of scheduled airline performance and dependability has been brought within a weight and price range suitable even for light aircraft.
A.R.C. Type 11 Specifications
RECEIVER: Frequency Range: 190-550 KC
Sensitivity: 2 microvolts or better
Selectivity: Signal 30 db down at 3 KC off resonance, and 60 db down at 5 KC off resonance
Reception Distance from Standard Airways Range Station: 200 miles under normal conditions
TRANSMITTER: Frequency: 122.1 mc and 122.5 mc, or any 5 crystal controlled frequencies in any 1 MC band between 121.5 and 132 mc.
Power Output: 1.1 watts
Modulation: Over 90% modulation capability
Transmission Distance: Over 30 miles at 2000 feet or higher
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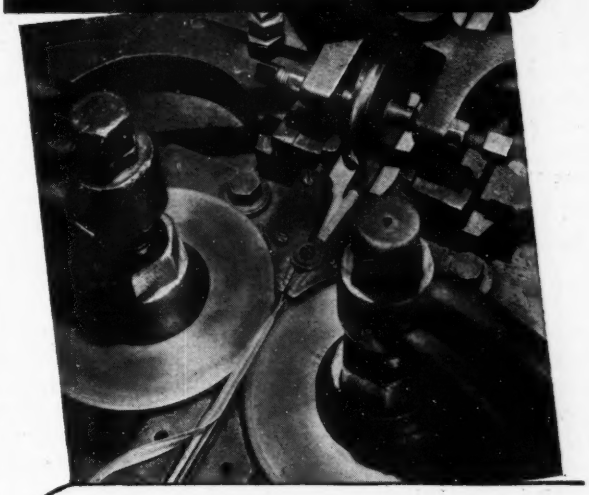
short facts about long-lived cable



● The strip insulating process insures perfectly-centered conductors in all Okonite wires and cables. The Okonite Company, Passaic, New Jersey.

look for the single ridge

OKONITE SINCE 1878

insulated wires and cables for every electrical use

index. To each of the first three chapters a table listing typical compounds along with their boiling points, freezing points and densities is appended. The text is liberally dotted with references to the original literature and is nearly free of typographical errors.

I found the anthropomorphic attributes given to silicon, such as, ". . . under favorable conditions silicon will *abandon* linkage with hydrogen . . .", or, "silicon will *seek* combination with oxygen . . ." somewhat disconcerting. That the author's theoretical chemistry appears to be of 1923 vintage is reflected in the general discussion which comprises the first five pages and in some of the definitions given in the glossary (see: activation energy, bond energy, nascent, etc.). However, the chemical and physical facts are well presented in a readily accessible, and hence useful form.

A rough count of the references quoted in the first two chapters shows that the largest portion of the fundamental investigations in this field was done prior to the last decade. In the third and subsequent chapters wherein the exploitation of this basic work is described, the references are predominantly to more recent publications and to patents. The modern tools for fundamental studies in molecular structures and chemical kinetics have yet to be applied to this very rich field of chemistry.

This book is recommended as a useful addition to your library.

S. H. Bauer
Asst. Prof. of Chemistry

College News

(Continued from page 20)

School of Mechanical Engineering, joined the Cornell University faculty in 1939. During the war he assisted Prof. Lynn Emerson in drafting, editing and developing various ordnance monographs for the war effort. Recently he gave a paper, "Training Inspection in Gaging in Mechanical Engineering" at the First National Convention of the Instrument Society of America held in Philadelphia.

Dave Esperson

(Continued from page 17)

to Phillips Academy in 1938. It is interesting to note that sports, which play such a prominent part in our school life, were literally shelved in France, never being recognized as part of the normal school system. The American students were influencial in introducing basketball to the French in 1934.

Dave's only hobby is flying, but lack of "cabbage" grounded Dave most of the year. Dave completed his final term and graduated with a degree of Bachelor of Mechanical Engineering this February. With a final look at the Cornell campus and a successful Junior Week under his belt, Dave left his present address, Theta Xi fraternity, where he has been president this year, and moved to Syracuse. He will work for General Electric in setting up production lines in an electronics plant. And with the ushering in of the March breezes, Miss Caroline Rattelman Arts '45, became Mrs. David H. Esperson on March 1. The best of luck to you both.

Welders

(Continued from page 13)

rod decomposes into gases and slag. Of greater importance are the gases which, in addition to shielding the electric arc, protect the weld from the sulfate and phosphate impurities in the water. Otherwise, these materials might embrittle the metals as it cools.

Beware of Moisture

When they are to be immersed in water for only a few minutes, standard coated electrodes, applicable also to topside welding, are entirely satisfactory. The rate at which the coating absorbs moisture is relatively slow, and hence the electrodes are not seriously impaired. However, when they are to be exposed to water for long periods, it is good practice to coat the standard electrodes with a thin layer of varnish or cellulose acetate. Acetate has been found more desirable since it dries almost immediately, while varnish remains sticky for hours. These coatings not only waterproof the electrode but improve the arc stability by introducing an additional gaseous shield about the molten metal. In recent years, however, coated electrodes specially waterproofed for underwater welding have appeared commercially. These can resist lengthy contact with water without noticeable effect.

If the welding equipment is to withstand repeated use, all parts of the underwater circuit must be adequately insulated. Otherwise any exposed metal surfaces will be gnawed away by the electrolysis which occurs inevitably in the highly conducting sea water. Of further advantage, the use of insulation limits current losses. Today a fully insulated electrode holder, expressly designed for underwater welding, is a standard accessory. Even so, the insulation is not complete unless all external metallic portions of the welder's diving suit are also properly protected. Only in this way is the welder guarded against electrical shock. Furthermore, the electrode holder is much too deadly a weapon to be regarded lightly. For instance, if the diving helmet lacks insulation and the welder accidentally touches it with his electrode, he will very quickly burn a hole through it. The likely result is drowning.

The Well-Dressed Diver

A regular diving outfit, including a helmet, rubberized suit, weighted shoes, and belt weights, is normally required in underwater operation. But even this costume is not absolutely essential. When welding is done in shallow water, merely a light-weight helmet with no additional waterproofing, except perhaps a coat of grease, is all the welder needs. Nevertheless, welders dressed in this fashion will find their work appreciably more hazardous than if they were wearing a closed suit. The danger of shock is noticeably accentuated. For instance, if the welder is changing electrodes and the generator is running, he is very apt to get a severe jolt due to current leakage from the welding leads. If only because these occasional shocks introduce a highly objectionable nuisance factor, it is normally preferable for the

(Continued on page 32)

Smörgåsbord for Boilers...

Coal, gas, and oil (fired singly or in combination) are regular items on today's menu for B&W boilers. Occasional entrees include: grain hulls, wood chips, asphalt, sewage sludge, by-products of paper mills, steel plants and sugar mills...just about anything that burns. So B&W builds boilers and combustion equipment that burn what's available today... likely to be available tomorrow...at top efficiency.

Helping power plants to get the most from available fuels is only one of the things long years have taught B&W to do well. Industry offers examples of many others—proof of the imaginative engineering at B&W.

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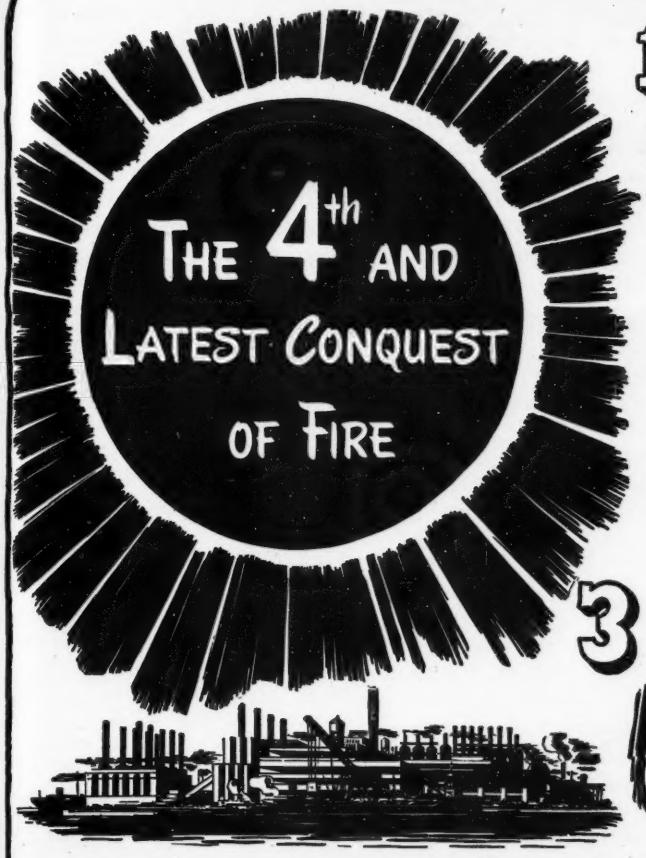
THE MARCH OF SCIENCE

THE 4th AND LATEST CONQUEST OF FIRE



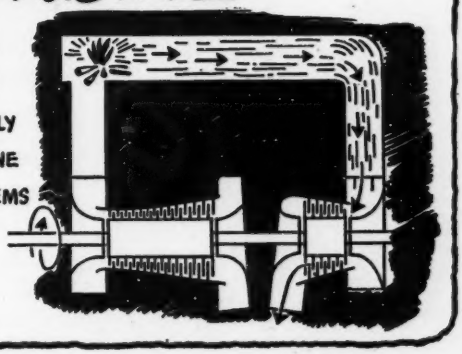
1 FIRE·· THE DIFFICULT THING ABOUT FIRE IS THAT IT'S HOT! IT BURNS! BUT PRIMITIVE MAN LEARNED TO USE THIS HEAT TO WARM HIMSELF···COOK··· HARDEN CLAY··· SOFTEN AND MELT METAL.

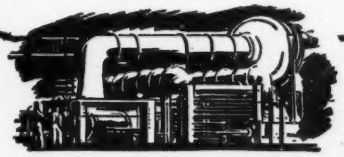
2 FIRE COULDNT BURN WATER—INSTEAD IT CHANGED IT TO STEAM. SO MAN HARNESSED STEAM, USING FIRE INDIRECTLY TO PUSH A PISTON—TURN A WHEEL AND SHAFT....

3 FIRE-PISTON-SHAFT·· INVENTION OF THE INTERNAL COMBUSTION ENGINE ELIMINATED STEAM AS A LINK···BROUGHT FIRE CLOSER TO THE CRANK··· BUT THE FRICTION OF RECIPROCATING MACHINERY STILL LOSES POWER··· CAUSES WEAR.

4 THE GAS TURBINE··

NOW, IN THE GAS TURBINE, FIRE IS APPLIED DIRECT TO THE SHAFT. A COMPRESSOR SUPPLIES AIR TO THE COMBUSTION CHAMBER. FUEL BURNER HEATS AIR, GREATLY INCREASING ITS VOLUME. HEATED AIR RUSHES THROUGH TURBINE AND TURNS SHAFT. SOUNDS SIMPLE BUT MANY TOUGH PROBLEMS OF DESIGN AND METALLURGY HAD TO BE SOLVED TO MAKE IT PRACTICAL.....





MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS HAS MADE MORE INDUSTRIAL GAS TURBINES THAN ALL OTHER COMPANIES COMBINED! WORK IS NOW GOING FORWARD FOR THEIR USE IN POWER PLANTS, LOCOMOTIVES, FAST SHIPS, PLANES, JUST ONE MORE EXAMPLE OF A-C LEADERSHIP IN SCIENTIFIC DEVELOPMENT OF BETTER MACHINERY FOR ALL INDUSTRY

ALLIS CHALMERS

ONE OF THE BIG 3 IN ELECTRIC POWER EQUIPMENT
BIGGEST OF ALL IN RANGE OF INDUSTRIAL PRODUCTS

Welders

(Continued from page 30)

welder to wear a complete diving suit.

Current Requirements

Since the heat of the arc is mainly dependent upon the electrical current, it is all-important that the highest permissable current be utilized. To offset current and heat losses through the water, underwater welding demands approximately 10 per cent higher current than the setting specified for similar work in air. The minimum current is 150 amperes, while the upper limit approaches 300. With a view toward promoting greater arc stability, direct current is used exclusively.

What About Voltage?

The open-circuit voltage is ordinarily on the order of .80 volts, while the arc voltage ranges between 25 and 35. Striking and holding an arc under water is somewhat more difficult than in air since the pressure of the water tends to snuff out the arc almost before it has a chance to get started. To counteract the pressure effect, the arc voltage must be boosted as depth is increased. Most commonly, the negative terminal of the generator is hooked to the line leading to the electrode holder, while the positive terminal is clamped to the base metal. This connection is characterized as "straight polarity." If accidentally the polarity should be reversed, electrolysis takes a field day on the uninsulated metal surfaces in the underwater circuit.

Caution: Undercutting

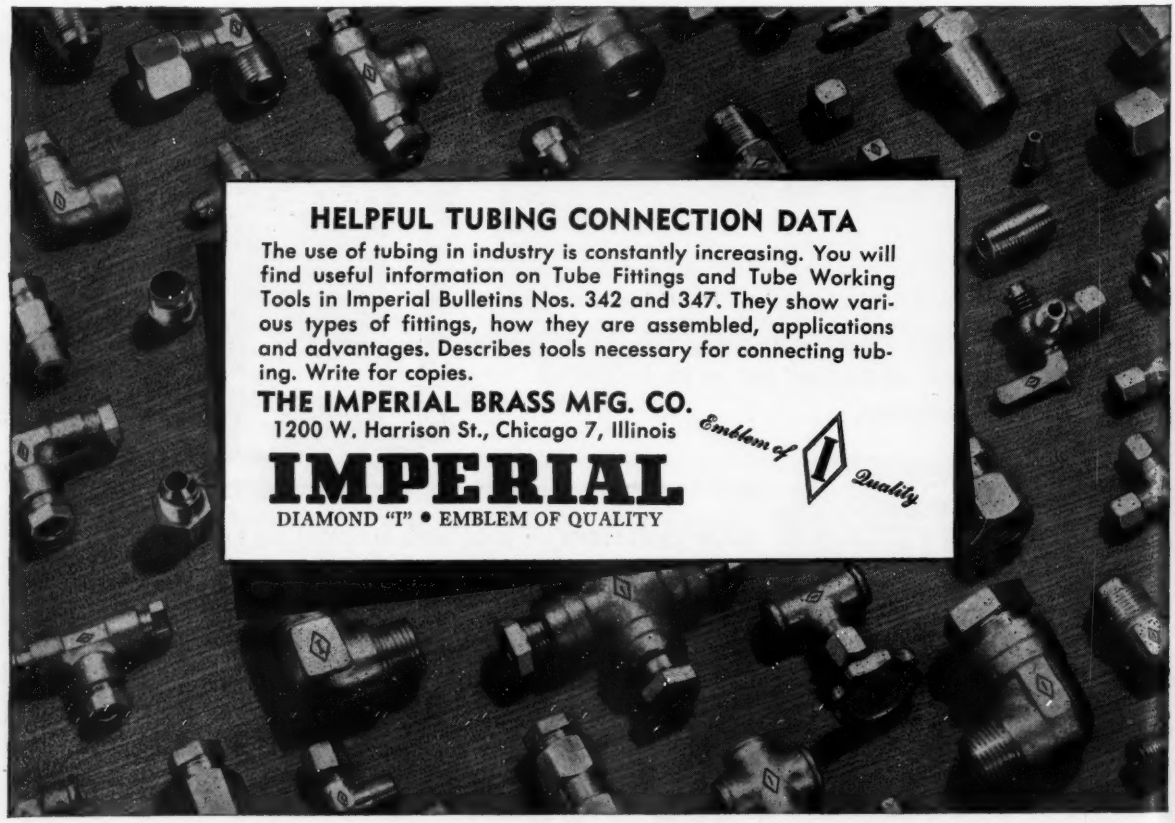
The higher current and voltage settings required in sub-surface welding aggravate the tendency toward undercutting. This condition refers to welds in which the deposited metal does not entirely fill the crater which the arc has burned in the base metal. The notches produced along the edges of the weld by undercutting may seriously weaken the final welded joint. To reduce or eliminate undercutting and its detrimental effects such factors as arc length, speed of travel, and electrode angle must be given due consideration.

Because welding under water is not altogether unlike trying to play a violin in a suit of armor—blindfolded—the operation demands extreme care and skill. The operator must contend with a diving suit which is heavy and seldom, if ever, comfortable. He is opposed by a continual current or tide which may turn even the simplest welding job into an up-hill fight to maintain a stable arc. Besides, there is always the prospect of freezing-cold water, difficult positioning, and the fatiguing effects of depth.

Welding In The Dark

As if he were not vexed sufficiently, the underwater welder is also obliged in a great number of cases to work in complete darkness. Not only is it likely that the water around him will be swarming with debris, but he may be forced to weld in semi-enclosed compartments where invariably sunlight fails to penetrate. Artificial lighting may be improvised, but it is only a makeshift. On the other hand, no matter how good the lighting may be, the welder seldom sees either the molt-

(Continued on page 34)


HELPFUL TUBING CONNECTION DATA
The use of tubing in industry is constantly increasing. You will find useful information on Tube Fittings and Tube Working Tools in Imperial Bulletins Nos. 342 and 347. They show various types of fittings, how they are assembled, applications and advantages. Describes tools necessary for connecting tubing. Write for copies.
THE IMPERIAL BRASS MFG. CO.
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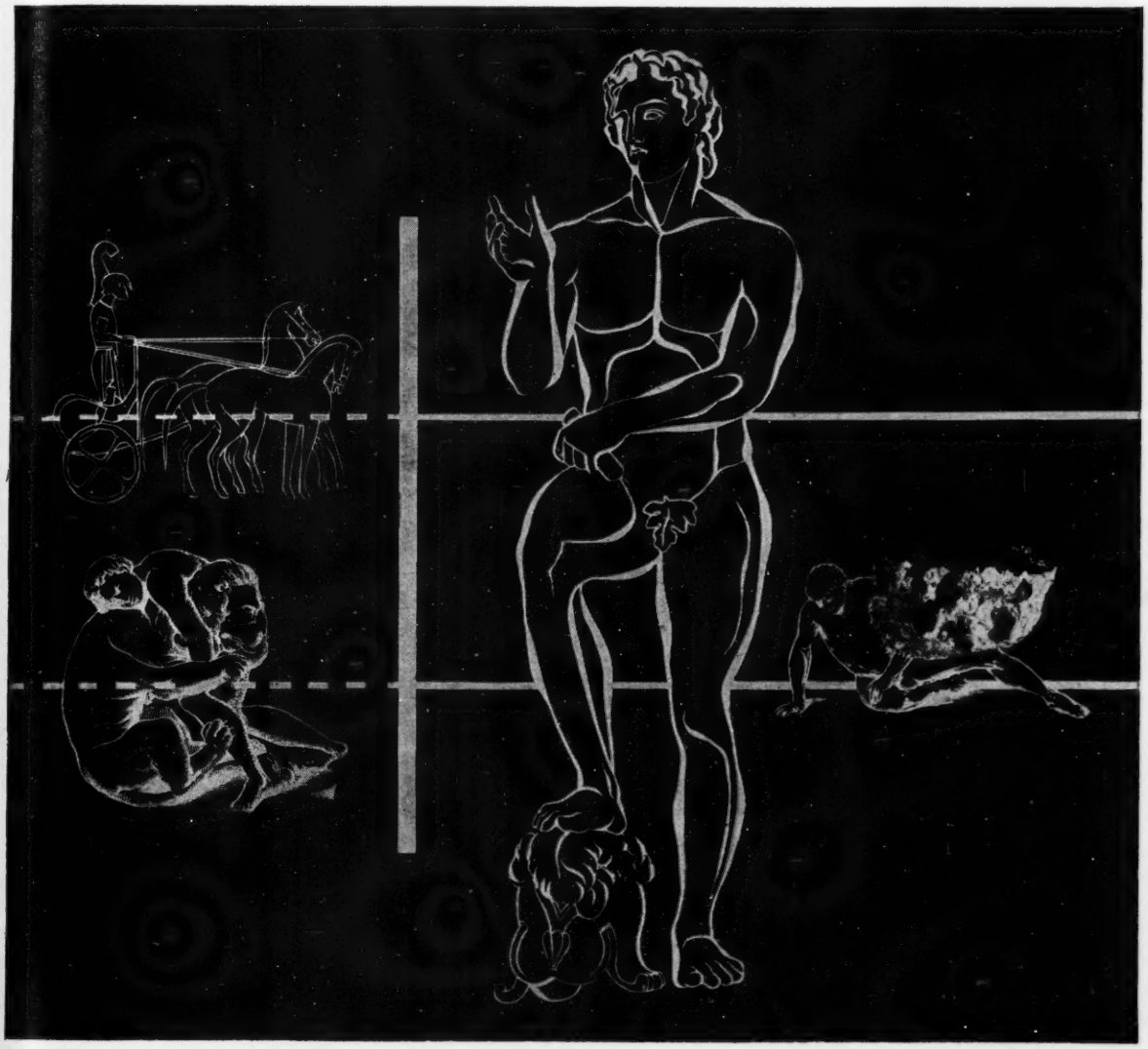
IT TAKES MORE THAN MUSCLE

According to legend, Polydamas, the Greek athlete, killed a lion with his bare hands, stopped a chariot in full flight, and lifted a raging bull off the ground with ease. His career, however, came to a spectacular end when he tried to catch a huge falling rock.

Today, sudden, heavy loads end the life of many steel parts. Low temperatures, for instance, can have a depressing effect on the impact strength of steels. Molybdenum steels, which combine deep hardening and freedom from temper brittleness, reduce this risk.



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MOLY

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The Hershey (Pa.) Arena seats 7,000, Uses Frick Refrigeration.

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Star of the movie "Ice Capades of 1941", and now head of a troupe of skaters appearing in leading hotels, Miss Lewis uses a portable ice rink built by the Gartner Refrigeration Co., Frick Distributors at Minneapolis. ● And when she skates on permanent rinks, the chances are they're also operated with Frick Refrigeration—more than half of all those on this Continent are! ● If you want dependability with economy, insist on Frick Refrigerating, Ice-making and Air Conditioning Equipment.

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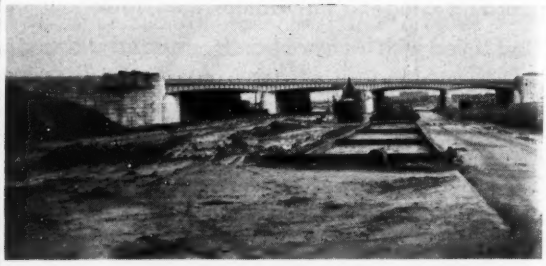
Bridge Construction



Project: Bridge No. 4, network of roads leading to Pentagon Building, Arlington, Va. Built for Public Roads Administration. Completed 1942.

Cayuga Construction Corp.

30 Vesey Street, New York 7, N. Y.

Daniel M. Lazar '29, President
L. Sanford Reis '29, Treasurer

Welders

(Continued from page 32)

en crater of metal or even the tip of his electrode. A dense cloud of bubbles usually surrounds the arc. In addition, escaping metal particles, produced much in the same way as the colloidal solutions of gold and silver, dye the water an inky black. These particles almost entirely conceal the arc, although the effect is considerably reduced if the water is free running.

Touch System

In underwater welding, it is always desirable to use the shortest possible arc. Only in this way will the maximum heat be delivered to the welded joint. However, since the maintenance of a consistently short arc requires that the welder hold his electrode above the base metal with an extremely steady hand, this operation is seldom practical by standard techniques. Equally good results, affording much less strain to the operator, may be obtained by the method of "touch welding." In this system, the welding rod, properly tilted, is allowed to rest lightly on the base metal along one edge of the electrode coating. This coating is an excellent electrical insulator. It extends slightly beyond the core metal of the electrode because the coating normally burns slower than the core. During welding, the end of the core rod is separated from the base plate on which the electrode rests by a short but fixed distance, depending upon the angle of tilt of the welding rod. In this manner, a consistently short arc, and thus optimum welding heat, is maintained with minimum effort required of the welding operator.

Positions

Underwater welding, however, may be done in any of the standard positions—downhand, vertical, and overhead. Of these, the most relaxed position is downhand. Under favorable diving conditions, a capable welder can turn out a fillet weld at an average speed of from 15 to 20 feet per hour.

Under Test

Tensile tests on butt-welded joints indicate that the results of underwater welding closely approximate those of welding in air. For other types of joints, however, the tensile strengths of underwater welds range from 70 to 80 per cent of those obtained by topside welding. Ductility is cut in half. Since high tensile steels are severely hardened by the rapid water quench, these metals are usually avoided. In the main, only mild steels are recommended for underwater welding.

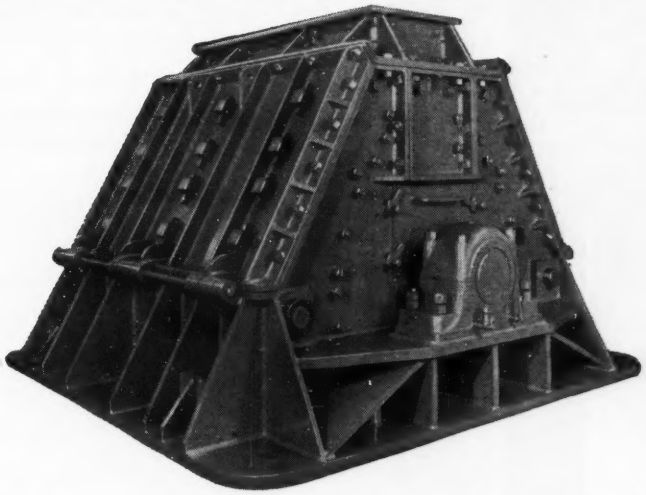
Training of Welders

Quite obviously, an underwater welder is not just an experienced welding operator who happens to be wearing a diving suit. Underwater technique is distinctive in itself. Even the most talented surface welder, accustomed to wearing little more in the way of extras than light gloves and an eyeshield, requires at least 30 to 60 hours of actual practice before he can claim competence for sub-surface work. About 150 hours of welding is demanded of beginners. Their job is two-fold. Not only must they mas-

(Continued on page 36)

"PENNSYLVANIA" IMPACTOR

For Difficult Reductions of Ores and Industrial Minerals



The "Pennsylvania" **Impactor** upsets time-honored concepts of preparing Ball and Rod Mill feeds. Steelbuilt **Impactors** are ruggedly engineered and provide **Large** reduction ratios. These patented **Impactors** reduce highly refractory Chrome Ores, Clinkers, Electric Furnace Refractories, and a wide range of Ores and Industrial Minerals. The principle of **impact** reduction is by hard, fast, head-on smashing against powerful Steel Anvils.

IMPORTANT IMPACTOR FEATURES

1. **Low "Overgrinding":** Impactor "fines" average substantially lower than with other types. Impact reductions are measured in split-seconds — no time for "Milling" and excessive fines.
2. **High Reduction Ratios:** Feed sizes range up to 10", with reductions to minus #20 to #50 mesh, depending on requirements. 6" down refractory ores reduced for efficient Ball Mill feed.
3. **Cubing "Particle Shape":** Hard, smashing impact produces particles predominantly cubing, few slivers, few "smooth rounds." No other reduction machine compares in this respect.
4. **Natural Separation:** When gravity differences exist between a mineral and its softer impurities, the quick impact-shocks by the IMPACTOR help to effect a natural separation of the mineral from its gangue. This subsequently simplifies the Flow Sheet and cheapens the subsequent concentration processes.
5. **Accessibility:** Removal of a few cover keybolts permits quick inspection, or replacement of worn parts.
6. **Reversibility of operation:** A reversing motor-switch permits IMPACTOR operation in **either** direction. This is important.

If interested, write for Bulletin.

PENNSYLVANIA CRUSHER CO.

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NATIONAL
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We've been searching around for good table radios at a reasonable price and we think we've found them. These REGAL RADIOS have six tubes and bring in distant stations just like large console radios. The cases are attractive and compact and the tone is good. Two models.

Standard Broadcast $29.95
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THE CORNELL CO-OP
Barnes Hall — On The Campus

Welders

(Continued from page 34)

ter the art of welding, but they must also become proficient divers. It takes considerable savvy to do both jobs and do them well.

During the recent war, the Navy Diving School in Washington, D. C., trained scores of men for salvage work. Today, in addition to Navy schools, there are diving and underwater welding institutes in various parts of the country. Gradually the ranks of competent underwater welders are being filled by men trained not only by formal classroom instruction but by that most exacting teacher of all—on-the-job experience. The special skills possessed by these welders are quickly becoming indispensable for the type of construction and repair in which the overriding considerations are speed and dependability. Whether they're bushleaguers who have yet to learn all the delicate refinements or whether they're ring-tailed whizzes who can hold an arc with the best of them, industry vitally needs arc welders who can go below in diving suits.

Opportunities

(Continued from page 15)

machine into high gear with the most serious lack of skilled and semi-skilled labor in history.

The development of the airplane and subsequent shortening of distances, high speed trains, and other transportation means require improved and continually improved equipment, methods, and technical services.

The chemical industries are on the threshold of their greatest productivity. New materials, metals and synthetics, already developed or well on the way to completion, demand technical help never dreamed of before. Additional power is in demand and, with the probable use of atomic energy, the utility or general power field will undergo a tremendous upheaval and technical change. The use of electronics has just begun, not only in communications but in control of everything under the sun. Gas turbines are with us not only for use in airplanes but are equally useful on ships, locomotives, and other means of transportation.

Many of these new, radical and now well-known things have been developed by industries and will continue to be developed as industrial research has reached a plane so high that, under our economy, only with such organization and the competitive spirit can we progress as we have.

Communication in a peace time world has necessarily lagged as have all phases of our normal peace time activities. Our friends in telephone and telegraph are finding it necessary to expand and develop to keep up with the increasingly complex communication systems.

Material Shortage

One of the more critical problems of today is our material shortage, particularly in the fields of metals and metal products. We all have read about shortages of copper, steel, and lead. One of the basic reasons for this is that the returning G.I. does not want to mine metals and coal. This means that further technical development of mining and metal processing equipment, as

(Continued on page 38)

Du Pont Digest

Items of Interest to Students of Science and Engineering

The Synthesis of Nylon

Chemists of original nylon research team honor memory of Dr. Carothers at the dedication. They are: J. W. Hill, Ph. D., M. I. T. '28; H. B. Dykstra, Ph. D. Ohio State '27; G. J. Berchet, Ph. D. Colorado '29; J. E. Kirby, Ph. D. Iowa State '29; E. W. Spanagel, Ph. D. McGill '33; D. D. Coffman, Ph. D. Illinois '30; and F. J. Van Natta, Ph. D. Michigan '28. Dr. Carothers received his Ph. D. from Illinois in 1924.

Dr. Wallace Hume Carothers

1896-1937, was the first organic chemist in industry to be elected to the National Academy of Sciences. During his short scientific career he made contributions that have greatly enriched American life.

Recently the Nylon Research Laboratory near Wilmington was dedicated as "The Carothers Research Laboratory," in honor of the late Wallace Hume Carothers and his classical researches on the structure of polymers, the mechanism of polymerization, and the invention of nylon.

In 1928, a group of chemists under Carothers began a study of polycondensation which led eventually to the discovery of nylon. The project was part of a program of fundamental research to discover scientific facts which might be of eventual value in laying a foundation for applied research.

As the first point of attack, they chose the condensation of dibasic acids with glycols and reaction materials which would preclude the formation of rings. They obtained linear polymers of molecular weights between 2300 and 5000.

Molecular Weights Increased

After two years, a significant advance in linear polymer preparation was achieved. Through the use of the molecular still, it was possible to obtain materials of molecular weights between 10,000 and 25,000, which, when molten, could be drawn into filaments.

More important, the cooled superpolyester filaments could be further drawn into fibers several times their original length and thereby acquired luster, tensile strength, elasticity, pliability, and toughness much greater than the initial polymer. In contrast with ordinary textile fibers, their tensile strength was unchanged by wetting.

The striking properties of the fibers aroused the hope of finding a commercial fiber from some type of linear superpolymer. Investigation showed, however, that fibers from the polyesters were too-low melting and too soluble for textile purposes. Mixed polyester-polyamides were also not of interest in this category.

Research on Fibers

The possibility of a commercial fiber development seemed remote, but the intuition that frequently accompanies research genius prevailed, and Carothers was encouraged to direct his research on superpolymers specifically toward spinnable fibers. A polyamide from 9-aminonanoic acid gave a fiber of 195°C. melting point, equal in strength to silk, and clearly indicated the possibility of obtaining a material for fibers of commercial utility.

In 1935, the superpolymer from hexamethylene diamine and adipic acid was first synthesized. It melted at 263°C., was insoluble in common solvents, tough, elastic and had the best balance of properties and manufacturing costs of any of the polyamides then known.

A third period of research covered commercial development. The task was enormous, and to reduce to a minimum the "time between the test tube and the counter" a large force of some of the most competent chemists, physicists, chemical and mechanical engineers available was assigned to the project. The story of the manufacture of nylon will be told next month.

More facts about Du Pont—Listen to "Cavalcade of America," Mondays, 8 P.M. EST, on NBC

Questions College Men ask about working with Du Pont

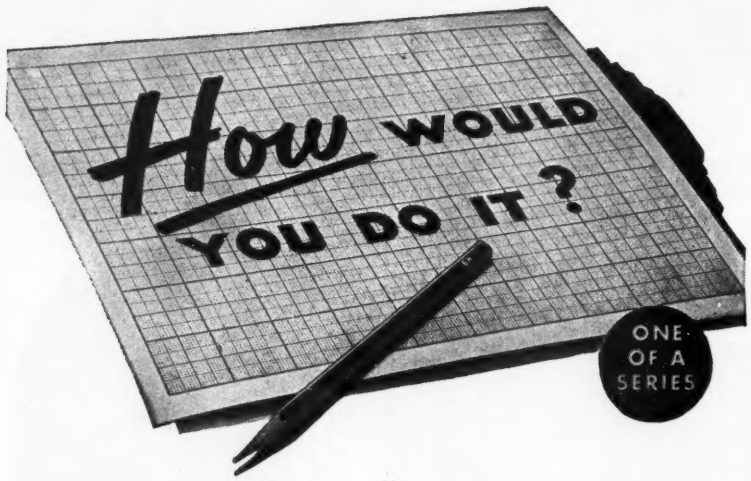
Where would I be located?

Openings for technical graduates may exist in any one of the 35 Du Pont research laboratories or 83 manufacturing plants. Every effort is made to place men in positions for which they are best suited and in the section of the country which they prefer. Write for new booklet, "The Du Pont Company and the College Graduate." 2521 Nemours Bldg., Wilmington 98, Delaware.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY



PROBLEM — You are designing an automobile service car with a crane on the back end. You are going to take power from the transmission to drive the crane drum. How would you do it?

THE SIMPLE SOLUTION — Use an S.S.White power drive flexible shaft. Connect one end to a take-off on the transmission and the other end to the clutch which operates the crane drum—simple, easy to install, good for positive, dependable operation.

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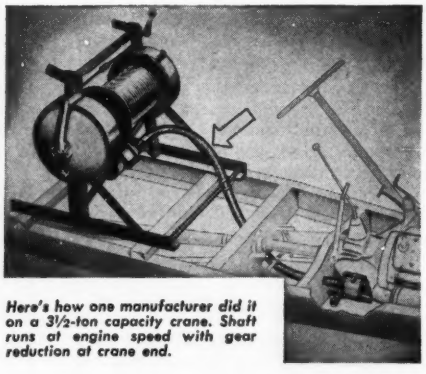
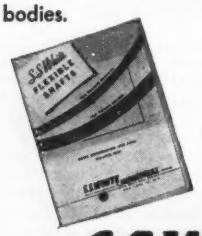
This is just one of hundreds of remote control and power drive problems to which S. S. White flexible shafts provide a simple answer. Engineers will find it helpful to be familiar with the range and scope of these useful "Metal Muscles"* for mechanical bodies.



Here's how one manufacturer did it on a 3½-ton capacity crane. Shaft runs at engine speed with gear reduction at crane end.



WRITE FOR BULLETIN 4501
It gives essential facts and engineering data about flexible shafts and their application. A copy is yours for the asking. Write today.

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S.S.WHITE INDUSTRIAL DIVISION
THE S. S. WHITE DENTAL MFG. CO. — DEPT. C, 10 EAST 40th ST., NEW YORK 16, N. Y.
FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED RUBBERS • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING

One of America's AAAA Industrial Enterprises

Opportunities

(Continued from page 36)

well as safer and better working conditions, must be developed in order to again attract young men to these industries.

Young Graduate

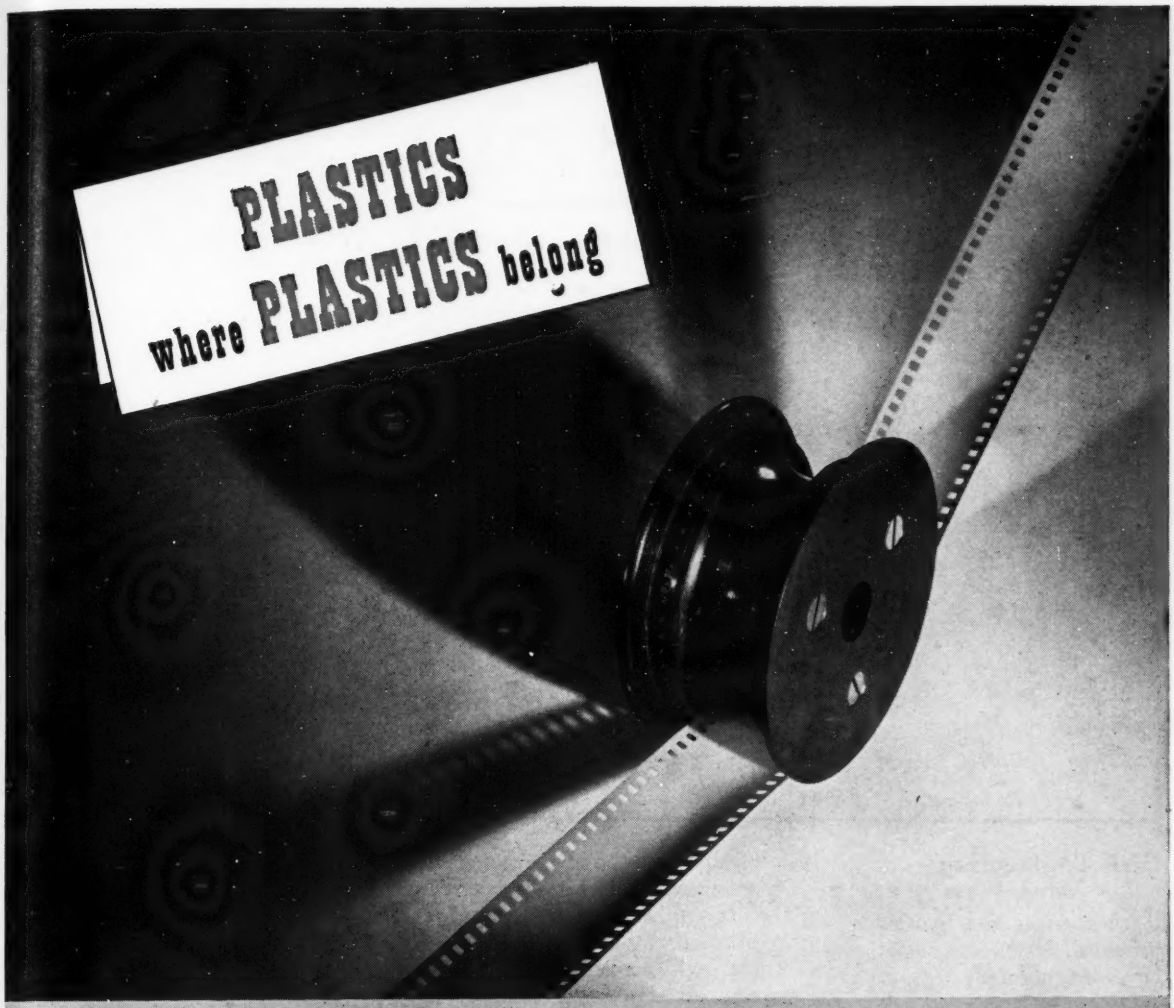
One could continue indefinitely in such an analysis of all industries and services. We can see for ourselves the conditions with which we are faced. We must depend on the young technical graduate to carry on in spite of these difficulties in the industrial world and expect him not only to provide the peace time goods and services, but also to continue to develop better weapons for defense and to keep ahead of other countries to provide in America the standard of safe living which we all demand.

Under these conditions industry cannot again afford to use technically trained men on anything but jobs requiring their full abilities. New industries demand technical manpower be taught this important fact, and the colleges must produce to the limit the quality of men needed to do this tremendous task. There can be no place for any but the strong in this race.

In War and Peace

The unbalanced age distribution alone among our technical people will force these younger men to spread themselves over a wide band of responsibilities, and they will be required to take over older men's jobs at a rate never before equalled. We need the maturity of the returning service men and we must teach these boys that they have responsibilities just as deep as those that they had during their war service. They won the war and they must keep America and the whole world going ahead. Those in industry are just as responsible for our future welfare as any other group.

These facts can then be called the opportunities for the technical graduate in industry. There can be no ceiling for the young graduate who possesses these traits and abilities that make for success, and his opportunities today are greater than ever before or that he will ever have again.



Using Corrosion Resistance, Strength, and Machinability

MOVIE FILM carriers are an excellent example of using plastics where plastics belong.

The film carrier illustrated is only one of many types made from Synthane laminated plastics. Synthane is well-suited for the job because it stoutly resists the corrosive action of developing solutions.

The teeth, though small, must be strong and accurately indexed. They are easily milled from Synthane.

Whenever in your future work you have an application for laminated plastics, let us know about it—*before* you design, if possible.

Synthane's help includes design, selection of the right material, and fabrication by men who know plastics. Synthane Corporation, Oaks, Penna.

SYNTHANE TECHNICAL PLASTICS DESIGN • MATERIALS • FABRICATION

SHEETS · RODS · TUBES · FABRICATED PARTS · MOLDED-MACERATED · MOLDED-LAMINATED

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GRAPHITE CRUCIBLES
REFRACTORY CRUCIBLES
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From the Following Materials:—

GRAPHITE SILICON CARBIDE FUSED ALUMINA MULLITE
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◆

LAVA CRUCIBLE COMPANY of PITTSBURGH
Pittsburgh, Pennsylvania

Civil Engineering

(Continued from page 8)

in these areas and hydraulics will be added. Staff accommodation will be added, naturally.

Staff

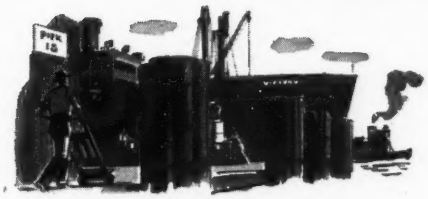
The work of this school in its early years as has been mentioned was done by a comparatively small number of men of national reputation. This staff grew in members until it numbered about 35 members not incuding assistants. Later when the Civil Engineering profession became stabilized and other Engineering Colleges were established, the College (later the School) undergraduate body declined.

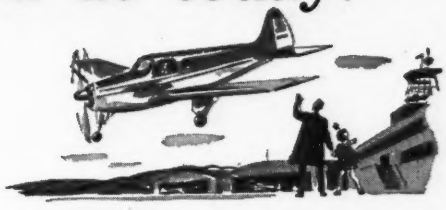
Today many of the senior members of staff are reaching the retiring age. Within five years practically the entire staff of 1938, when the writer came to Cornell as a member of the faculty, will have to be replaced. Those who carried the work of the school during the depression years of 1929-1934 and the war years can rightly feel that a task well done is a fitting reward for the long arduous years. Of the loyalty of the staff the writer cannot speak too highly.

It will be the task of the administration of the School to see that the replacements have the same high standards, the same loyalty, and the same enthusiasm. With the competition we have from industry and other institutions, the task will be difficult. So far, our replacements give promise that our high hopes will be attained.

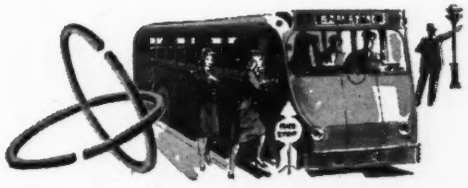
Testing Soil with a consolidating machine in the Civil Engineering Soil Testing Lab.

What did you do today?





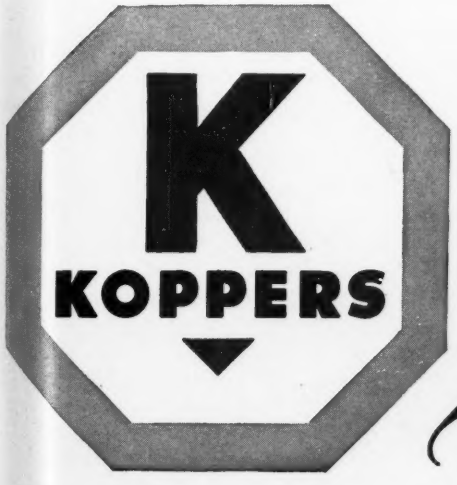
If you visited the waterfront[1] . . . . . or watched a plane[2]



. . . or turned on the radio[3] . . . . . or boarded a bus[4] . . . .

. . . saw a freight car[5] . . . . . or went to the dentist[6] . . . .

. . . lighted a candle[7] . . . . . or bought a necktie[8] . . . . . .



you saw a Koppers product in use[9]

1. Wood piling, pressure-treated by Koppers to protect it against marine borers. **2.** Koppers Aeromatic variable-pitch propellers. **3.** Koppers chemical ingredients for plastic radio cabinets. **4.** Koppers American Hammered Piston Rings. **5.** Wood for car construction, pressure-treated by Koppers for extra-long life. **6.** Koppers chemical ingredients for novocain. **7.** Koppers candles. **8.** Koppers chemicals for use in making dyes. All these are made by Koppers . . . as well as scores of other useful and familiar things. All bear the Koppers trade-mark of quality . . . the symbol of a many-sided service. Koppers Company, Inc., Pittsburgh 19, Pa.

Silicones

(Continued from page 10)

runner of silicone rubber, or Silastic. Silicone rubber compounds withstand both low and high temperatures without damage, and although initial batches of Silastic had relatively low tensile strength and tear resistance, recent major improvements have been made in these properties. Silastic is being used as covering on wire and cable as well as for resilient tubing and gaskets for high temperature uses.

Silicone Insulation

The tremendous importance of silicone insulation has been proven by engineers in over four years of evaluation, and their work has barely begun. It is true that silicones are not the solution to all insulation problems, but their combination of the two outstanding properties of rubber and asbestos, the ability to withstand high temperatures and resistance to moisture, points to an outstanding future for silicone insulation.

ZINC INSTITUTE 2 OZ. COATING SEAL OF QUALITY

The "Seal of Quality", shown above, is the yardstick of economy in buying galvanized sheets. It signifies at least 2 oz. of Zinc per square foot!

The U.S. Bureau of Standards, Circular #80, says, ". . . by far the best" protective metallic coating for rust-proofing iron or steel is ZINC. Zinc, in the form of galvanizing, protects against rust in TWO WAYS: First, by simple coverage, with a sheath of rust-resistant metal . . . Second, by electro-chemical action, or "sacrificial corrosion." That's why industry has long depended on ZINC to stop rust—cut costs—save materials. Heavy coatings pay—for the heavier the coating, the better the protection, the longer the service life and the lower the cost.

FREE BOOKLETS

WRITE TODAY for these valuable booklets: (1) Repair Manual on Galvanized Roofing & Siding (2) Facts About Galvanized Sheets (3) Use Metallic Zinc Paint to Protect Metal Surfaces (4) The Zinc Industry—Mine to Market.

American Zinc Institute

Room 2618—35 East Wacker Drive, Chicago 1, Illinois

Alumni News

(Continued from page 24)

This system, which will make it possible for "any traveler to find any address without a map or other help," actually consists of numbering all streets according to grid coordinates. The general plan is to number the streets north, south, east, and west, allowing one hundred numbers for each street; and one hundred numbers for the houses in each block. It is by giving one hundred numbers to each block that streets can be found by the numbers on the houses. Addresses in this system are given by the number of the house on the street, such as 50 West, and then the number location of the street, such as 200 North. The completed address is 50 West 200 North Street, Ithaca, which is the address of Rand Annex using the intersection of Tower Road and East Avenue as the central point from which the numbering begins, and numbering one hundred numbers to the block. Using this system, even Hotel students could find Franklin Hall.

This system is at a disadvantage in large cities where the numbers of houses are irregular and the people tend to be sentimental about street names. However, Utah fits well into the plan, and the inhabitants of the state will profit greatly. Dr. Lyman's system is a great step forward in Civil Engineering.

EE '25 and AIEE

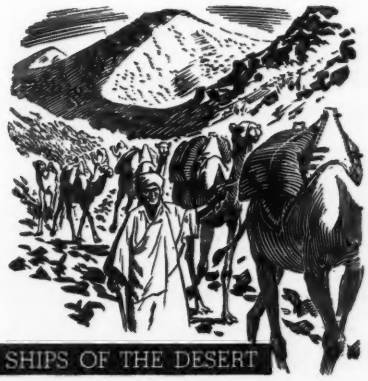
"New Developments in Sub-Miniature Tubes" was discussed by Walter Jones, chief engineer of the Sylvania Electric Products Company when he addressed the Ithaca section of the American Institute of Electrical Engineers on February 7.

Mr. Jones graduated from Cornell in 1925 with the degree of Electrical Engineer. During the war, he was actively engaged in the solution of problems involving special tubes for radar and other military needs and had a large part in the development of the tiny tubes used in the proximity fuse. His topic, of which he has intimate knowledge, was one of great interest to the profession.

THE STORY OF CHROMIUM

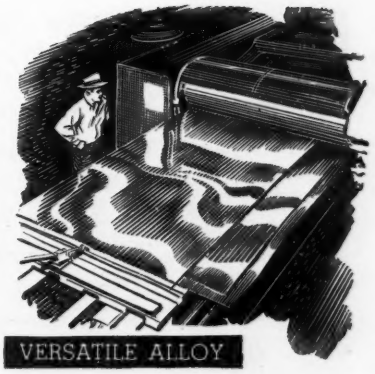
COLOR FOR ARTISTS

The yellows, blues, and violets of the artist's palette; the red of the ruby, the green of the emerald — all come from chromium, a metal named from the Greek word *chroma*, meaning color. Discovered in 1797, this metal was for years just a laboratory curiosity, but is now top-ranking among alloys.



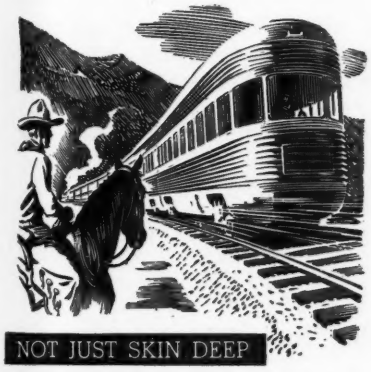
SHIPS OF THE DESERT

Caravans of camels laden with chromite ore have often formed the first link on an assembly line thousands of miles long. From the mines of Rhodesia, Turkey, Russia, and India this valuable ore starts its long journey to Electromet furnaces, where dozens of different types of chromium alloys are produced.



VERSATILE ALLOY

This silvery-white metal, used with steel and iron in amounts from 1 to 35 per cent, imparts many of its own desirable properties. To stainless steels, chromium gives resistance to heat, rust, and corrosion—to heat-treated steels, strength and resistance to shock—to cast iron, hardness and wear resistance.



NOT JUST SKIN DEEP

The luster of stainless steel withstands all weather conditions—on streamlined trains as well as on skyscrapers. For hospital, food, and dairy equipment, too, this steel is popular, since it is so easy to clean and sterilize. And for the oil and chemical industries, its resistance to corrosion and heat makes it ideal.

BEARINGS TO BATTLESHIPS

Axles and armor plate, dies and drills, shafts and springs — these are made from engineering steels that must have the hardness and strength necessary to withstand wear and strain. That's why engineers specify steels with 1 to 3 per cent chromium for applications where dependability is essential.

It's Been A Long Time

...since Electromet started to produce ferro-alloys — 40 years ago. In fact, as far back as 1897, a plant in Virginia, which later joined Electromet, was the first to produce ferrochrome commercially in the United States. Electromet is constantly developing new and better alloys, among them the low-carbon ferrochrome essential in the production of stainless steels. You will learn more about chromium and other alloys by writing to our Technical Service Department for the booklet, "Electromet Products and Service."

ELECTRO METALLURGICAL COMPANY

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC New York 17, N. Y.

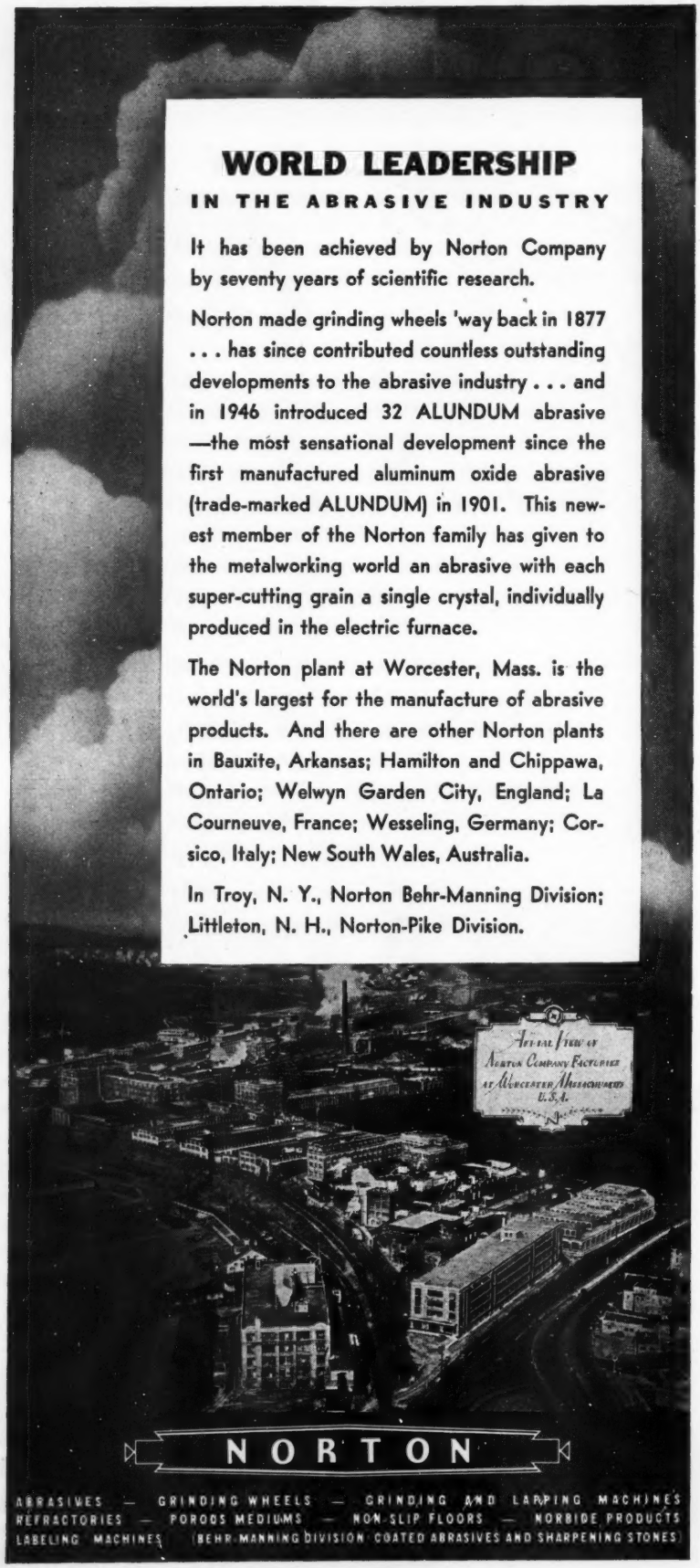
ELECTROMET Ferro-Alloys and Metals are sold by Electro Metallurgical Sales Corporation, and Electro Metallurgical Company of Canada, Limited, Welland, Ontario.

P-19455A

Electromet

TRADE-MARK

Ferro-Alloys & Metals


WORLD LEADERSHIP
IN THE ABRASIVE INDUSTRY
It has been achieved by Norton Company by seventy years of scientific research.
Norton made grinding wheels 'way back in 1877 . . . has since contributed countless outstanding developments to the abrasive industry . . . and in 1946 introduced 32 ALUNDUM abrasive —the most sensational development since the first manufactured aluminum oxide abrasive (trade-marked ALUNDUM) in 1901. This newest member of the Norton family has given to the metalworking world an abrasive with each super-cutting grain a single crystal, individually produced in the electric furnace.
The Norton plant at Worcester, Mass. is the world's largest for the manufacture of abrasive products. And there are other Norton plants in Bauxite, Arkansas; Hamilton and Chippawa, Ontario; Welwyn Garden City, England; La Courneuve, France; Wesseling, Germany; Corsico, Italy; New South Wales, Australia.
In Troy, N. Y., Norton Behr-Manning Division; Littleton, N. H., Norton-Pike Division.
Aerial View of Norton Company Factories at Worcester, Massachusetts U.S.A.
NORTON
ABRASIVES — GRINDING WHEELS — GRINDING AND LAPPING MACHINES
REFRACTORIES — POROUS MEDIUMS — NON-SLIP FLOORS — NORBIDE PRODUCTS
LABELING MACHINES (BEHR-MANNING DIVISION) COATED ABRASIVES AND SHARPENING STONES

Techni-Briefs

(Continued from page 18)

perception. In an ordinary camera this property is wasted because the light reflections focus on a flat surface, but in Trivision the standard film is embossed on the side opposite the emulsion with microscopically small ridges or lenticulations. These ridges, numbering about 200 per linear inch, act as simple plano-convex cylindrical lenses, each one dividing its portion of the image into two parts. The camera is designed so that it scans the subject laterally and the film is moved during exposures to obtain the maximum depth or relief.

The results of this complicated process are quite astounding. An ordinary portrait looks the same whether viewed from the front or to one side. In a Trivision picture it is actually possible to see around and beyond objects as one changes his angle of view. Objects in the foreground move in relation to objects in the background, and foreground objects seem to project out of the photograph or mount itself.

This process will be of great value in motion pictures, X-rays, and aerial reconnaissance work as well as portraiture. The navy has already spent over one million dollars developing the process, and working out a photo-engraving process to pick up the depth perception of the Trivision camera.

New Insecticide

A new insecticide toxicant, proved in preliminary tests to be fully as effective as DDT against certain types of insects and more effective against others, has recently been developed. This insecticide, given the trade name "Toxaphene," by its manufacturers the Hercules Powder Company, is a chlorinated camphene compound. It is found to be equally effective in either agricultural, household, or industrial insecticides. Pests such as cotton insects, flies, clothes moths, and roaches, to name a few of the most common, can be easily controlled by these Toxaphene-containing insecticides.

Barr and Lane, Inc.

Builders

NEW YORK OFFICE
145 E. 32nd ST.
NEW YORK 17,
NEW YORK

ITHACA OFFICE
SIBLEY DOME BLDG.
CORNELL UNIVERSITY
ITHACA, N. Y.

STRESS and STRAIN...

Woman—Person that can hurry through a store aisle 18 inches wide without breaking the delicate merchandise and then drive home and knock the doors off a 15 foot garage.

* * *

Prof: "Who was the cleverest inventor?"

E.E.: "Edison, he invented the phonograph and the radio so people would stay up nights burning his electric light bulbs.

—Purdue Eng'r

* * *

Instructor: "This prelim will be conducted on the honor system. Please take seats three seats apart in alternate rows."

* * *

Then there's the one about the thrifty Scotchman, Mac, who wanted to get married but couldn't decide between two girl friends. His pal urged him to send a provisional proposal to both and choose on the basis of their replies. A telegram of acceptance arrived immediately from the first, but no response from the second. Hours passed. That night a telegram of acceptance came from the second. Mac's pal exclaimed, "Ye can have do doubt about it now. Marry the first girl—the other kept ye waiting a long time." "Nae, nae, mon," replied Mac, "The gal who waits for the night rates, that's the gal for me!"

* * *

"Did you hear about the calamity?"

"No, what happened?"

"Irvine stuck his head into Zinck's and hollered 'Fire'."

"Well?"

"They did."

* * *

Nute: "What are those marks on your nose?"

Tom: "Oh, they are made by glasses."

Nute: "You should learn to tilt your head back further, then it would pour out easier."

Carl: "Get your engagement ring?"

Dan: "Yeah, in the economy combination: Engagement, wedding and teething."

* * *

It was home work time at the Rubenstein home. "Benny," said Mama Rubenstein, "How many is seven and four?"

"Twelve," replied Benny.

"Not bad for a little shaver," volunteered Papa Rubenstein, "He only missed it by two."

* * *

Coed: "Do you think I'm conceited?"

M.E.: "No, why?"

Coed: "Girls as good looking as I am usually are!"

* * *

Newsboys Extra! Extra! Read all about it, two men swindled.

Passerby: Give me one.—Say there isn't anything in here about two men being swindled.

Newsboy: Extra! Extra! Three men swindled.

* * *

Two hicks fresh from the country, climbed aboard a Chicago bus. Wanting to see the sights, they paid their fares and went hurriedly up the narrow stairs. Suddenly they came tumbling down, eyes wide with fright.

"What's the trouble, no seats?" asked the conductor.

"No seats?" screamed one of the boys. "Plenty of seats, but no driver!"

* * *

Some Cornell drivers are in such a hurry to get into the next county on weekends that they can't stop but go right on into the next world!

* * *

Exercise kills germs, but we haven't found out how to get the darn things to exercise.

Mama Skunk was worried because she could never keep track of her two children, In and Out. Whenever In was in Out was out, and if Out was in then In was out. One day she called Out in and told him to go and bring In in. So Out went out and in no time he brought In in. "Wonderful," said Mama Skunk, "how in all this big forest could you find In in such a short time?" "It was easy," said Out. "Instinct."

* * *

M.E.: "Give me a cigarette, Joe."

Arts: "I thought you had quit smoking."

M.E.: "Well, I got to the first stage. I've quit buying."

* * *

Hig: "I'm betting on a horse that's starting at twenty to one, and I can't lose."

Milo: "Why?"

Hig: "The race starts at one."

* * *

"Did you hear about the wreck?"

"No!"

"Yeah, four professors and one student were killed."

"Poor fellow."

* * *

To remember the prelim, tie a string around your finger. To forget it, tie a rope around your neck.

* * *

"Do you really believe engineers like conceited Cornell coeds better than the other kind?"

"What other kind?"

* * *

C.E.: "I wish I could revise the alphabet."

Comstock Kid: "Why?"

C.E.: "I'd put U and I closer together."

* * *

"I just killed a female fly."

"How can you tell the difference between a male and a female fly?"

"That's easy, one lands on beer bottles and the other on mirrors."